Anritsu

INSTRUCTION MANUAL

OPTICAL HANDY POWER METER
ML9002A
AND
OPTICAL POWER SENSORS
MA9421A/MA9422A/MA9423A/
MA9621A/
MA9721A/MA9722A/MA9723A

PROPERTY OF
Electro Rent Corporation

FOURTH EDITION

M-Order No. W0400CE-4.0 1993. 12

CERTIFICATION

ANRITSU CORPORATION certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.
Anritsu further certifies that its calibration measurements are based on the Japanese Electrotechnical Laboratory and Radio Research Laboratory standards.

WARRANTY

All parts of this product are warranted by Anritsu Corporation of Japan against defects in material or workmanship for a period of one year from the date of delivery.
In the event of a defect occurring during the warranty period, Anritsu Corporation will repair or replace this product within a reasonable period of time after notification, free-of-charge, provided that: it is returned to Anritsu; has not been misused; has not been damaged by an act of God; and that the user has followed the instructions in the operation manual.

Any unauthorized modification, repair, or attempt to repair, will render this warranty void.

This warranty is effective only for the original purchaser of this product and is not transferable if it is resold.

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All requests for repair or replacement under this warranty must be made as soon as possible after the defect has been noticed and must be directed to Anritsu Corporation or its representative in your area.

OPTICAL HANDY POWER METER ML9002A AND OPTICAL POWER SENSORS MA9421A/MA9422A/MA9423A/MA9621A/MA9721A/MA9722A/MA9723A
INSTRUCTION MANUAL

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Printed in Japan

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WARNING

NO OPERATOR SERVICEABLE PARTS INSIDE.
REFER SERVICING TO QUALIFIED PERSONNEL.

CAUTION

FOR CONTINUED FIRE PROTECTION REPLACE
ONLY WITH SPECIFIED TYPE AND RATED FUSE.

Ni-Cd

WARNING

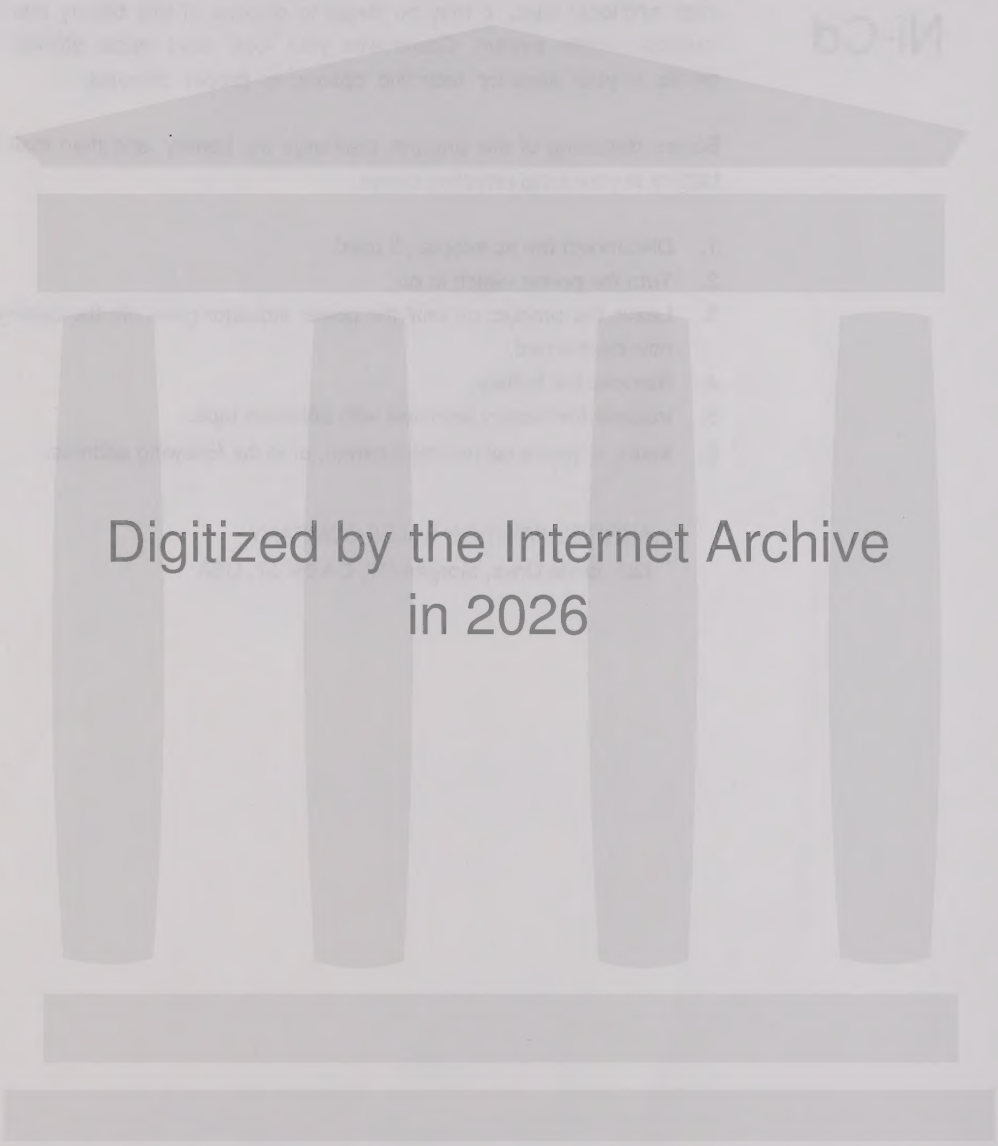
- To US Customers -

The product that you have purchased contains a rechargeable battery. The battery is recyclable. At the end of it's useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with your local solid waste officials for details in your area for recycling options or proper disposal.

Before disposing of this product, discharge the battery, and then mail the battery to your local recycling center.

1. Disconnect the ac adapter, if used.
2. Turn the power switch to on.
3. Leave the product on until the power indicator goes off; the battery is now discharged.
4. Remove the battery.
5. Insulate the battery terminals with adhesive tape.
6. Mail it to your local recycling center, or to the following address.

ANRITSU WILTRON SALES COMPANY
685 Jarvis Drive, Morgan Hill, CA 95037, USA



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Note:

WARNINGs, CAUTIONs, Notes, and explanatory footnotes are used in this manual. Their meanings are given below:

WARNING: WARNING is used when there is a personal injury hazard.

CAUTION: CAUTION is used when the equipment may be damaged.

Note: Note is used to provide information about exceptions, corrections, and restrictions.

Explanatory footnote:
Explanatory footnotes provide comments on the same page as the text, figure or table. They are referenced by either an asterisk (*) or by combination of an asterisk and numeral.

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SECTION 1

GENERAL

The ML9002A Optical Handy Power Meter can measure optical power levels from -70 to +20 dBm over the 0.38 to 1.8 μm wavelength range by combining it with an MA9421A, MA9422A, MA9423A, MA9621A, MA9721A, MA9722A, or MA9723A optical power sensors.

Since the optical power sensors are calibrated at three typical wavelengths, the absolute optical power can be read at each wavelength. In addition, the optical power sensors can be used by inserting them into the main unit or by connecting them to the main unit with a connecting cord.

Table 1-1 Sensors and Power Measurement Ranges

Main unit	Optical power sensor	Measurement wavelength range (μm)	Optical power measurement range (dBm) -70 -60 -50 -40 -30 -20 -10 0 +10 +20
ML9002A	MA9421A	0.38 to 1.15	
	MA9422A		
	MA9423A		
	MA9621A	0.75 to 1.7	
	MA9721A		
	MA9722A	0.75 to 1.8	
	MA9723A		

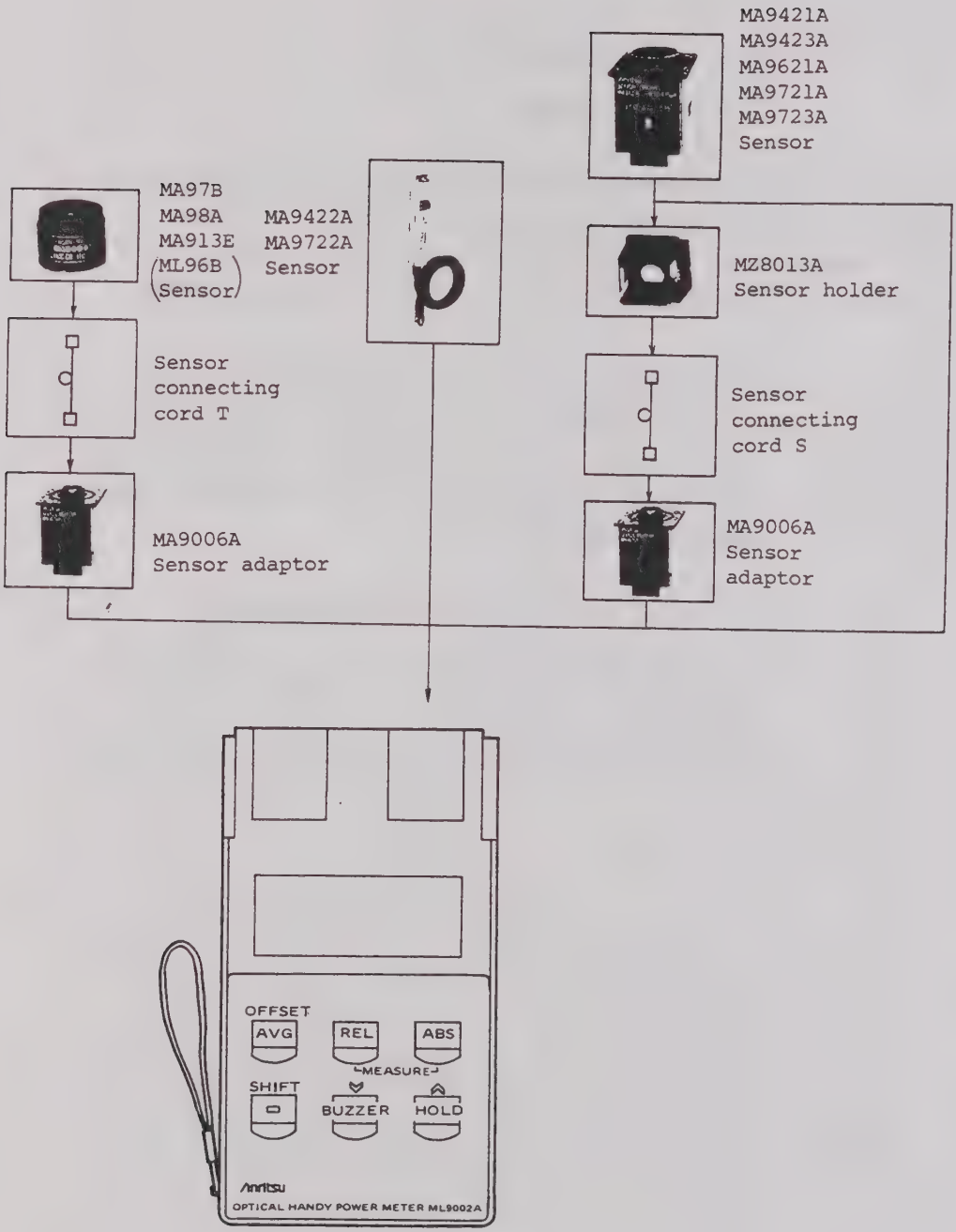


Fig. 1-1 ML9002A Family

SECTION 2

COMPOSITION AND SPECIFICATIONS

2.1 Composition

The standard composition of the ML9002A is shown in Table 2-1.

Table 2-1 Standard Composition

Item	No.	Name	Qty.	Remarks
Instrument	1	ML9002A	1	
Accessories supplied	2	AC adaptor	1	Z0178
	3	Power cord	1	
	4	Blank panel	1	B0232
	5	Auto-power-off override plug	1	J0477
	6	Instruction manual	1	W0400CE

2.2 Specification

Table 2-2 Specifications

Main Unit	Unit display	W, W (REL), dBm, and dB (REL) selectable, 4 digits						
	Recorder output	1 V/full-scale, 0.316 V/-5 dB						
	Averaging	ON/OFF settable						
	Range hold	Range settable						
	Buzzer	Sound threshold level settable (1 dB steps)						
	Auto power-off	After 5 minutes non-use (with built-in battery)						
	Dimensions (mm) and weight	190H x 90W x 38D, <700 g						
Optical power sensors	Type	MA9421A	MA9422A	MA9423A	MA9621A	MA9721A	MA9722A	MA9723A
	Wavelength (µm)	0.38 to 1.15 µm			0.75 to 1.7 µm	0.75 to 1.8 µm		
	Element used	Si diode			InGaAs diode	Ge diode		
	Active area dia.	ø9.5 mm	ø9 mm	ø9.5 mm	ø1 mm	ø5 mm	ø3 mm	ø1 mm
	Input type	Direct			FC connector adaptor	Direct		FC connector adaptor
	Measurement range (dBm)	-60 to +20 at 0.85 µm	-50 to +20 at 0.85 µm	-70 to +10 at 0.85 µm	-70 to +3 dBm at 1.3 µm	-40 to +10 at 1.3 µm	-50 to 0 *1 at 1.3 µm *2	-60 to +3 at 1.3 µm *2
	Dimensions (mm) and weight	30H x 30W x 37D, <100 g	16H x 15W x 140D, <200 g	30H x 30W x 37D, <100 g			20H x 20W x 128D, <300 g	30H x 30W x 37D, <100 g
Overall characteristics	Measurement accuracy	±5% at -10 dBm, 0.633,0.78,and 0.85 µm		±5% at -10 dBm, 0.66,0.78, 0.85 µm	±5% at -10 dBm, *3 0.85,1.3,1.55 µm		—	±5% at *3 -10 dBm, 0.85,1.3, 1.55 µm
	Measurement resolution	W/W (REL): 0.1% to 1%, dBm/dB (REL): 0.01 dB						
	Operation *4 hours	20 h (on internal Ni-Cd battery), floating operation possible						
	Temperature range	Use: 0° to 50°C, Storage: -30° to 50°C, Recharging: 10° to 45°C						

*1 Used for ø0.25 mm jacket diameter UV coated fibers

*2 Ambient temperature, rated range of use: 0° to 40°C

*3 When using the MA9721A/MA9723A at the wavelength 1.55 µm, the range of use temperature is 23°C ±5°C.

*4 When the internal Ni-Cd battery is fully charged.
The operating hour is decreased by number of chargings or storage condition.

2.3 Accessories (Sold separately)

Table 2-3 Accessories

Model/order No.	Name	Qty.	Remarks
MA9005A*	Connector adapter	1	For optical power sensor (FC-type connector adaptor as standard)
MA9006A*	Sensor adapter	1	For direct-input type sensor
MZ8013A	Sensor holder	1	
J0436	Optical power sensor connecting cord S	1	For optical power sensors of ML9002A
J0437	Optical power sensor connecting cord T	1	For optical power sensors of ML96B
J0438	Recorder output cord	1	
MP915A	Fiber adapter	1	125 μm clad
MP93A	Fiber adapter	1	
MP94C	Connector adapter	1	For MP93A
B0234	Battery box	1	
J0200B	Optical fiber cord	1	2 m, GI fiber
J0056B	Optical fiber cord	1	2 m, SM fiber
Z0179	Carrying case	1	
Z0182	Soft case	1	With shoulder strap

* MA9005A/MA9006A Options

Option No.	Optical connector type
21	D4
22	RUNGE
23	Amphenol TYPE 906
24	OF-2
34*1	DIAMOND
35	HP-SMA Amphenol TYPE 905
38	ST
39	DIN
40	SC
41*2	TOCP172
42	HFS-13/A
43	HMS-10/A

*1 HFS-3 (for GI)
HMS-0 (for SM)

*2 Only for MA9421A and MA9423A

SECTION 3

OPERATION

3.1 Handling Precautions

1. The battery charger (B0039) operates normally at 90 to 135 V for 100 V systems and 200 to 250 V for 200 V systems, at 50/60 Hz.

2. Turn off the power before changing or removing an optical power sensor.

   The optical power sensors are plug-in type, but optical power measurements can be made with the sensor separated from the main unit (ML9002A) by using connecting cord S (paragraph 3.3).

3. Excessive light input will damage the photodiode in the sensor.

   Do not input light exceeding the rated value.

4. When using the optical power meter in a bright place, be careful of external light leakage into the sensor.

5. When using a direct-input type optical power sensor without an adapter, note that when light strikes the area outside the active area of the crystal, the sensitivity changes. Use the optical power sensor so that the measurement light strikes the active area.

6. When a circuit with a low input impedance is connected to the recorder output terminal, an error is generated. Use a recorder with an input impedance of 100 kΩ or greater.

Since the recorder output is not averaged, when measuring low-level light, insert a suitable filter at the recorder output for averaging.

3.2 Environmental Conditions

(1) Operating conditions

The ML9002A operates normally at an ambient temperature of 0° to 50°C. However, do not use it in locations:

- Where it is damp or dusty
- Where there is exposure to active gases.

CAUTION

If the ML9002A is operated at room temperature after being used or stored for a long time at a low temperature, condensation may occur and cause short circuiting. Do not turn the power on until the instrument is completely dry.

---

(2) Storage precautions

Pay attention to the items listed below when storing the instrument for long time.

1. Always clean the instrument throughly before storage.
2. Do not store the instrument at high temperatures (55°C or more), high humidity (90% or more), or excessively low temperatures (-10°C or less).
3. Do not store the instrument in direct sunlight or in a dusty place.

4. Do not store the instrument in a place where it may be affected by condensation or corrosive gases.

(3) Recommended storage conditions

In addition to the conditions listed above, the following environmental conditions are recommended when storing the instrument for long time.

Temperature: 0° to 30°C
Humidity : 40% to 80%

The storage area should not be subject to large fluctuations in temperature and humidity during a 24-hour period.

3.3 Controls and Functions

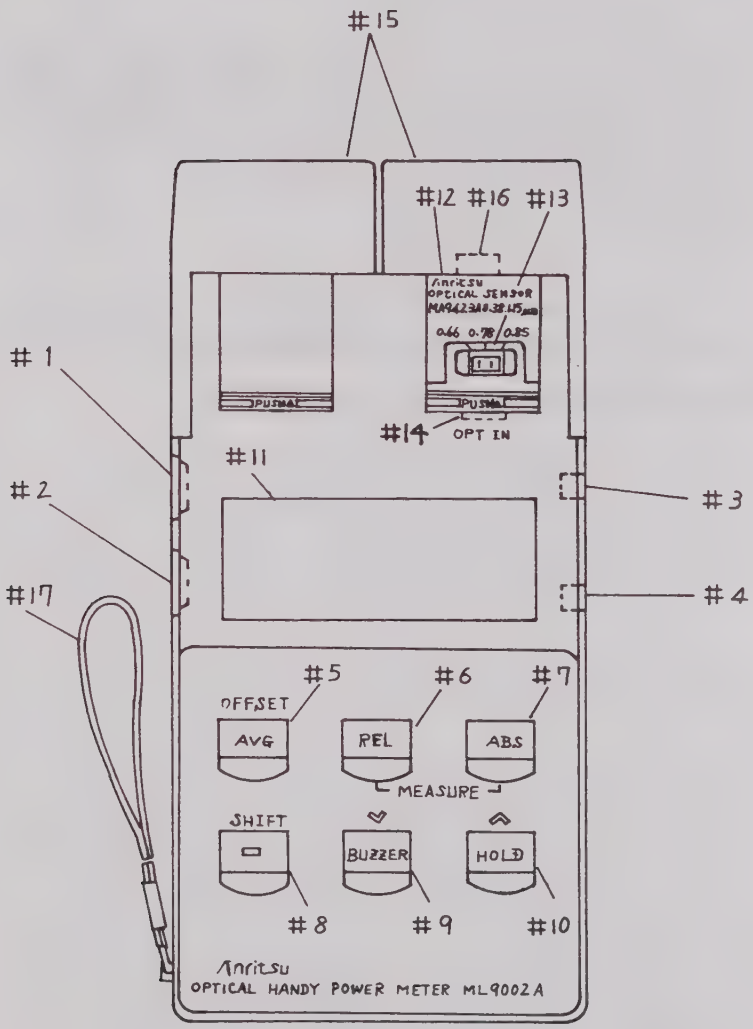


Fig. 3-1 ML9002A

Table 3-1 Description of ML9002A Operating Controls

No.	Label	Function
#1	POWER ON OFF	Power ON/OFF switch When an ML9002A key is not pressed for five minutes while operating on the internal battery, the power is turned off automatically. To turn on the power again, set this switch to the OFF position and then to the ON position.
#2	DISPLAY dBm W	Display #11 units Watt/dBm selector switch
#3	CHARGE 	Terminal to connect accessory charger when charging internal battery Six hours for full charge
#4	RCDR OUT 	Recorder output terminal Switches output range in 10 dB steps The full-scale output is 1 V. (For MA9722A/MA9723A, the full-scale output is 0.5 V at 0.85 µm.)
#5	OFFSET 	. AVG ..... Turns averaging on and off When averaging is on, the response becomes slow and "AVG" appears at the bottom of display #11. . OFFSET ... When this key is pressed when the [SHIFT] key LED is lit, optical power sensor zero adjustment is performed automatically. Always block the input light with protection cap #15 before performing zero adjustment.

Table 3-1 Description of ML9002A Operating Controls (Cont'd)

No.	Label	Function
#6	REL	. REL ..... When this key is pressed, the measured value at that time is displayed on the bottom line of display #11 and the difference between that value and the next measured value is displayed on the top line. To reset this function, press the [ABS] #7 key. When the measurement unit is Watts, W(REL) is displayed. In the W(REL) mode, the difference from the reference level displayed on the bottom line of display #11 is displayed on the top line. The W(REL) display range is within ±10 dB.
#7	ABS	ABS ..... When this key is pressed, the measured value at that time is displayed on the top line of display #11. The optical power sensor measurement wavelength or the buzzer level is displayed on the bottom line of display #11.
#8	SHIFT	SHIFT ..... When this key is pressed, the key LED lights and the shift mode is set. When the key is pressed again, the shift mode is reset and the LED goes off.
#9	⩒ BUZZER	. BUZZER ... When this key is pressed, the buzzer level appears on the bottom line of display #11 and " ·)) " is displayed at the bottom-left side of display #11. In the buzzer mode, when optical power over the buzzer level is input to the optical power sensor, an internal buzzer sounds. The buzzer level can be set in 1 dB steps by pressing the [⩒/BUZZER], [⩓/HOLD] keys in the shift mode. The initial buzzer level is the center value of the optical power measurement range of the optical power sensor. The buzzer mode cannot be used in the Watt display mode.

Table 3-1 Description of ML9002A Operating Controls (Cont'd)

No.	Label	Function
		. ⩒ ..... When this key is pressed in the shift mode ([SHIFT]) key LED on), in the buzzer mode, the buzzer level is lowered in 1 dB steps and in the range hold mode, the measurement range is lowered in one range steps. When the buzzer mode and range hold mode are set at the same time, the buzzer mode takes precedence.
#10	⩓ HOLD	. HOLD .... When this key is pressed, the measurement range is held at the current range and "HOLD" is displayed at the bottom of display #11. The range can be specified in one range steps by pressing the [⩒/BUZZER] and [⩓/HOLD] keys in the shift mode.
		. ⩓ ..... When this key is pressed in the shift mode ([SHIFT] key LED on), in the buzzer mode, the buzzer level is raised in 1 dB steps and in the range hold mode, the measurement range is raised in one range steps. When the buzzer mode and range hold mode are set at the same time, the buzzer mode takes precedence.
#11	(Display)	Liquid crystal display for measured values and measurement modes
#12	(Optical power sensor)	Plug-in optical power sensor
#13	(Wavelength selection switch)	Selects optical power sensor measurement wavelength

Table 3-1 Description of ML9002A Operating Controls (Cont'd)

No.	Label	Function
#14	(Optical power sensor connection terminal)	Accepts optical power sensor
#15	(Protection cap)	Protects optical input connector. Perform optical power-sensor zero adjustment with this cap closed. When measuring optical power, swing this cap up to the bottom of the power meter and use it as a tilt base.
#16	(Connector adaptor)	Optical input connector It can be replaced with one of several available connector adaptors.
#17	(Strap)	Prevents dropping main unit during measurement

3.4 Inserting/Removing Optical Power Sensor to/from ML9002A

3.4.1 Exposing connector adapter

Lift the protection cap in the (A) direction and swing it through 90° in the (B) direction to expose the connector adapter.

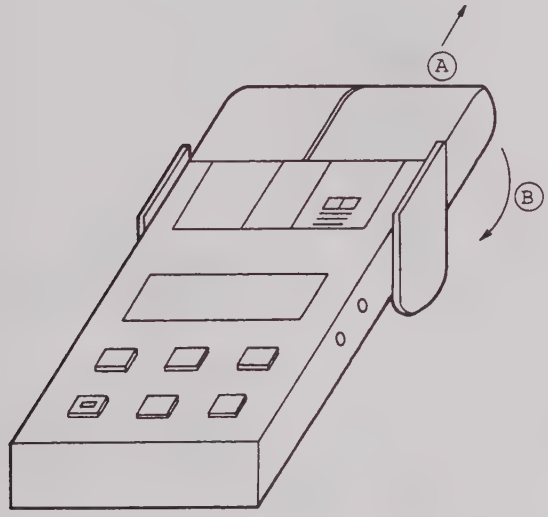


Fig. 3-2 Exposing Connector Adapter

3.4.2 Inserting sensor

Align the molded surface of an optical power sensor with the molded surface of the ML9002A and insert the optical power sensor in the arrow direction until the hook clicks.

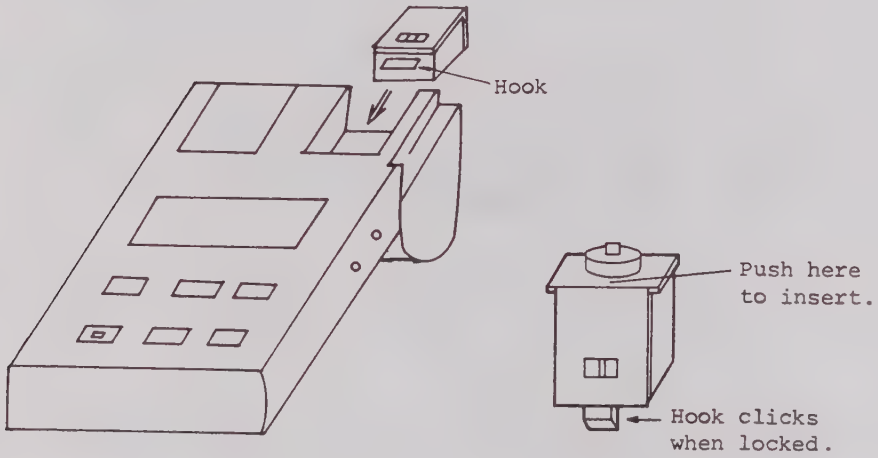


Fig. 3-3 Inserting Sensor

3.4.3 Removing sensor

Press the top of the optical power sensor in the (A) direction and push it in the (B) direction, simultaneously.

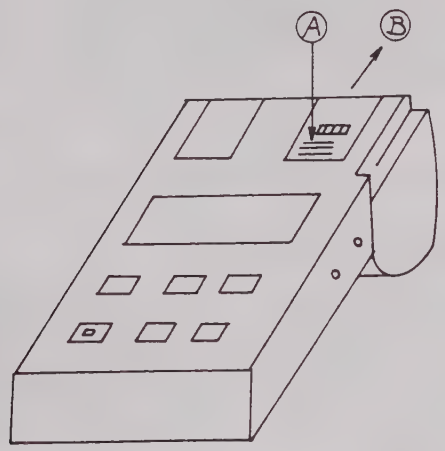


Fig. 3-4 Removing Sensor

3.5 Measurement

3.5.1 Turning on power

When the POWER switch #1 is set to the ON, all segments of display #11 light (display check). After the display check, ensure that the numeric display on the bottom line of display #11 is not flashing. If it is flashing, the capacity of the internal battery is low. Therefore, recharge the battery with the charger, or use the ML9002A on floating operation to allow the ML9002A to be used while the battery is charging.

When no ML9002A key is pressed for about five minutes, the power is turned off automatically.

During floating operation, however, the power is not turned off.

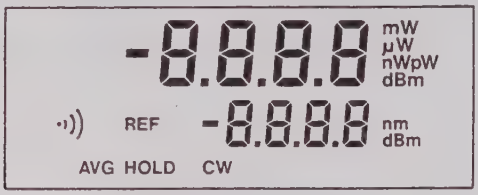


Fig. 3-5 Display

3.5.2 Overriding auto-power-off function

Normally, if no ML9002A key is pressed for about 5 minutes, the power is turned off automatically. But when the auto-power-off ovverride plug (supplied accessory) is inserted into the CHARGE terminal, the auto-power-off function does not operate.

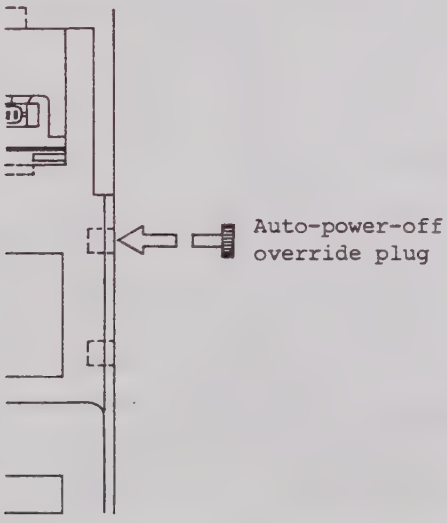


Fig. 3-6 Auto-Power-Off Override Plug

3.5.3 Zero adjustment

First, set POWER switch #1 to ON and set the DISPLAY switch #2 to select the display units W or dBm.

Next, completely block the optical input power to the sensor by closing protection cap #15 and perform zero adjustment by pressing the [SHIFT] and [OFFSET/AVG] keys, in this order. If measurements are made without performing zero adjustment, an error may occur.

During zero adjustment, "OFS" is displayed on the bottom line of display #11 and the key input is disabled.

Zero adjustment can not be performed if an optical power level of 6 dB or higher than the minimum measurement level is input to the optical power sensor. This is because a large error is generated when zero is adjusted in this state.

If the [SHIFT] and [OFFSET/AVG] keys are wrongly pressed for the zero adjustment, an error is recognized and "-E-" is displayed on the bottom line of display #11.

The buzzer sounds for 1 second to indicate the error.

3.5.4 Description of display #11

Each segment of the display is shown in Fig. 3-7.

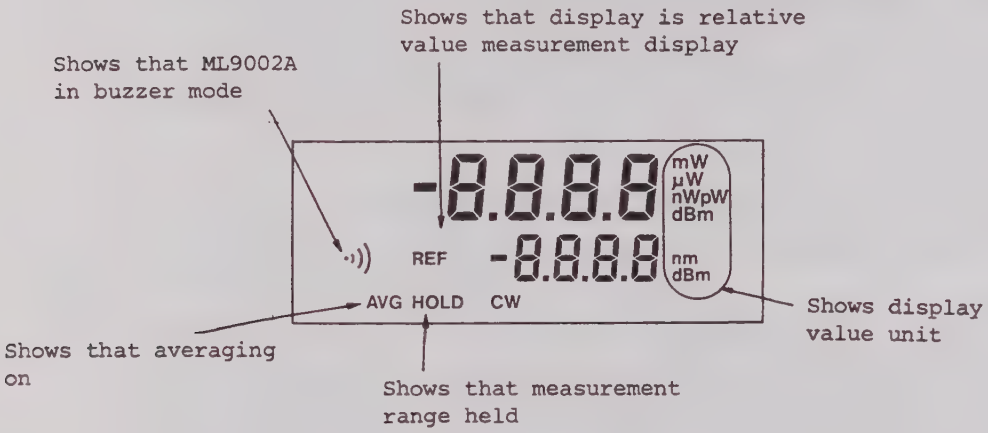


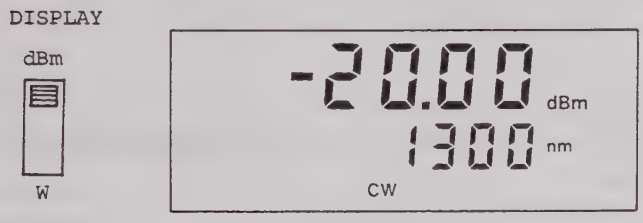
Fig. 3-7 Description of Display

3.5.5 Measurement

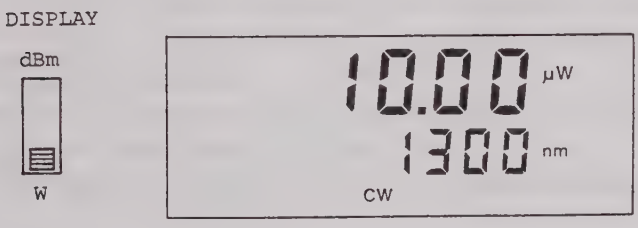
(1) Initial state

The initial state display is shown below.

(a) dBm display



(b) W (watt display)

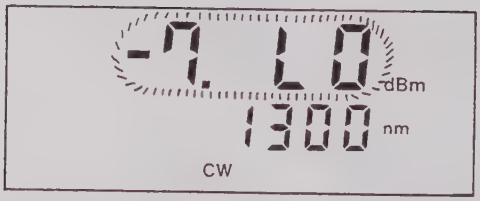


(2) OFFSET (zero adjustment) procedure

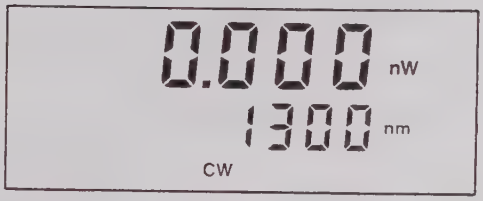
Block the input light to the optical power sensor using protection cap #15 before making this adjustment.

Step	Key setting	Function
1	[SHIFT]	Sets shift mode
2	[OFFSET]	Performs zero adjustment automatically

<dBm display>



<W (watt) display>



The display at the end of the OFFSET procedure is shown below.

Optical power sensor	dBm display	W (watt) display
MA9423A/MA9621A	-7.LO dBm	Less than ±0.01 nW
MA9421A/MA9422A/MA9722A MA9723A	-6.LO dBm	Less than ±0.1 nW
MA9721A	-4.LO dBm	Less than ±0.01 µW

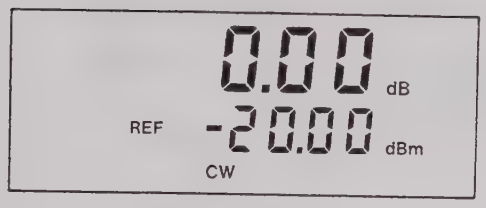
means flashing

(3) Relative value measurement procedure

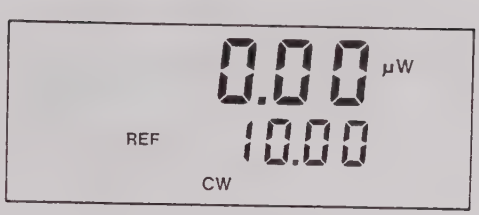
(a) Relative value measurement

Key setting	Function
[REL]	Displays reference level on bottom line of display #11 and relative value on top line.

<dBm display>



<W (watt) display>



(b) Relative value measurement by updating reference level

Key setting	Function
[REL]	Updates reference level

(c) Return to absolute value measurement

Key setting	Function
[ABS]	Returns display to absolute value measurement

(4) Procedure when making measurements by holding measurement range

(a) Holding current measurement range

Key setting	Function
[HOLD]	Holds measurement range at current measurement range

(b) Changing measurement range during hold mode

Step	Key setting	Function
1	[SHIFT]	Sets shift mode
2	[⩓]	Raises measurement range by one range
	or	
	[⩔]	Lowers measurement range by one range

(c) Resetting measurement range hold during hold mode

Key setting	Function
[HOLD]	Resets measurement range hold

Note:

When the measured value is larger than the held measurement range, that is, at over-range, for dBm display, "HI" is displayed and the most significant digit of the full-scale value at that time flashes.

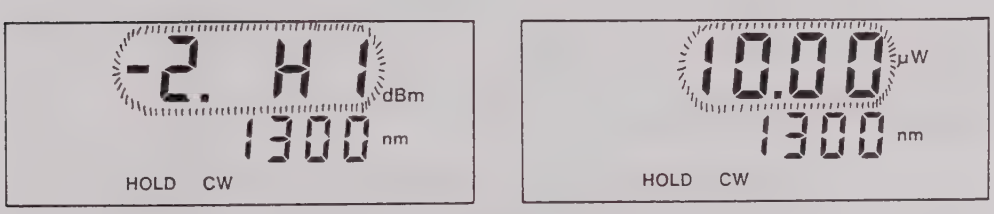
For W (watt) display, the display flashes at the full-scale value at that time.

Note (cont):

<Example>

When held at the -20 (10 µW) to -30 (1 µW) dBm measurement range

<dBm display> <W (watt) display:



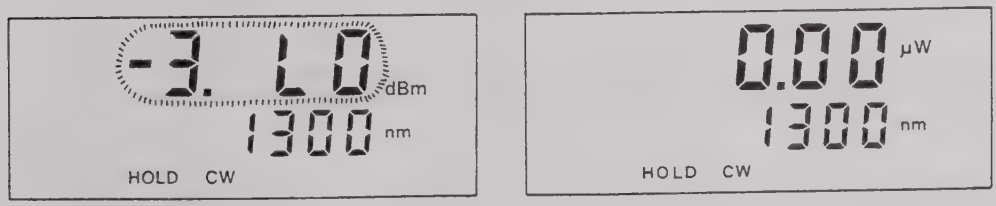
When the measured value is lower than the held measurement range, that is, at under-range, for dBm display, "LO" is displayed and the most significant digit of the minimum value of the range at that time flashes.

For W(watt) display, the minimum value is displayed.

<Example>

When held at -20 to -30 dBm measurement range

<dBm display> <W (watt) display>



(5) Procedure when making measurements using buzzer function

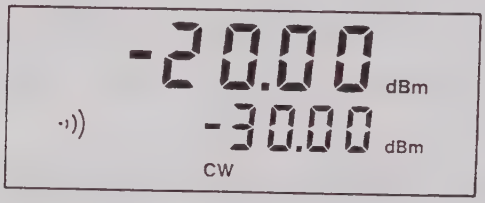
(a) Setting buzzer mode

Note:

The buzzer mode cannot be used with W (watt) display.

Key setting	Function
[BUZZER]	Sets buzzer mode The buzzer level is displayed on the bottom line of display #11.

<dBm display>



(b) Setting buzzer level

Step	Key setting	Function
1	[SHIFT]	Sets shift mode
2	[⩓] or [⩔]	Raises buzzer level by 1 dB. Lowers buzzer level by 1 dB.

(c) Resetting buzzer mode

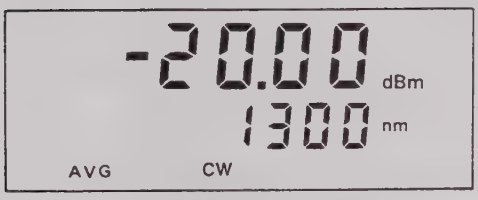
Key setting	Function
[BUZZER] or [ABS]	Release buzzer mode

(6) Procedure when making stable measurements using average function

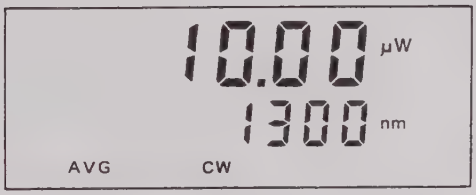
(a) Average measurement

Key setting	Function
[AVG]	Turns on average function

<dBm display>



<W (watt) display>



3.6 Application

3.6.1 0.85 µm band optical loss measurement

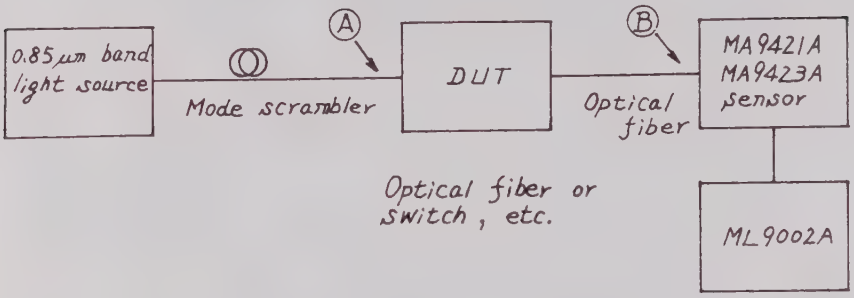


Fig. 3-8 0.85 µm Band Optical Loss Measurement Setup

Step	Procedure
1	After inserting the MA9421A or MA9423A Optical Power Sensor into the ML9002A, turn on the power.
2	Block light input by closing protection cap #15 and adjust zero.
3	Input the light to be measured.
4	Read the measured value displayed on the LCD.
5	When the optical power level before the device under test (DUT) in the measurement setup shown in Fig. 3-8 is A and the optical power level after the light has passed through the DUT is B, the optical loss of the DUT is C = A - B.

3.6.2 1.3 μm band optical loss measurement

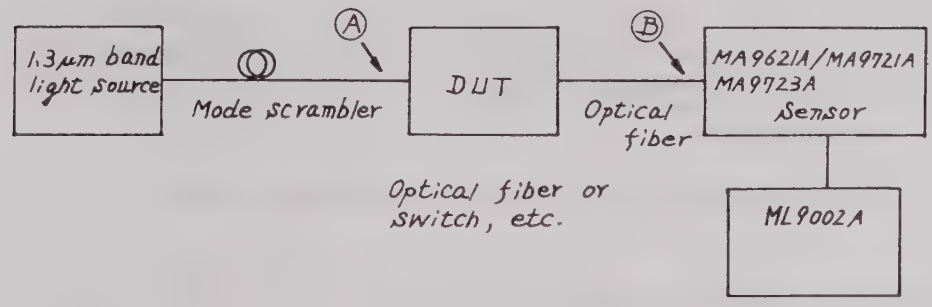


Fig. 3-9 1.3 μm Band Optical Loss Measurement Setup

Step	Procedure
1	After inserting the MA9621A, MA9721A, or MA9723A optical power sensor into the ML9002A, turn on the power.
2	Block light input by closing the protection cap #15 and adjust zero.
3	Input the light to be measured.
4	Read the measured value displayed on the LCD.
5	When the optical power level before the device under test (DUT) in the measurement setup shown in Fig. 3-9 is A and the optical power level after the light has passed through the DUT is made B, the optical loss of the DUT is C = A - B.

3.6.3 LD and LED optical power measurement

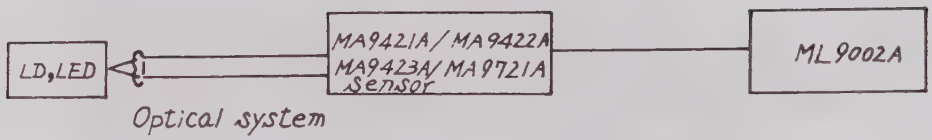


Fig. 3-10 LD and LED Optical Power Measurement Setup

Step	Procedure
1	After inserting the MA9421A, MA9422A, MA9423A, or MA9721A Optical Power Sensor into the ML9002A, turn on the power.
2	Block light input by closing the protection can #15 and adjust zero.
3	Build an optical system by using a lens, etc. and input the LD or LED light to the optical power sensor.
4	Read the measured value displayed.

Note:

RECORDER OUTPUT #4 is convenient when measuring the I-L characteristic of an LD or LED.

At this time, hold the range at maximum input from the LD or LED. The I-L characteristic can then be recorded on an external recorder by slowly changing the current I through the LD or LED.

3.6.4 Optical power stability measurement

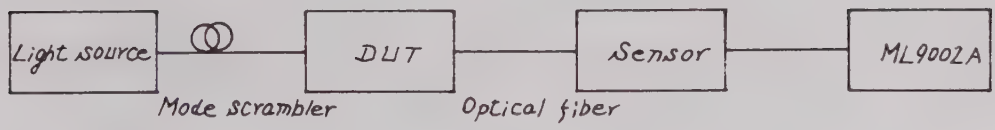


Fig. 3-11 Optical Power Stability Measurement

Step	Procedure
1	After inserting an optical power sensor into the ML9002A, turn on the power.
2	Block light input by closing protection cap #15 and adjust zero.
3	Input the light to be measured.
4	Read the measured value displayed on the LCD.
5	To measure the stability of the optical power, press the [REL] key #6. Measure the relative value at a resolution of 1/100 dB.

Note:

When measuring optical power by light input through a optical fiber, a connector adapter is necessary. An FC connector is the standard optical connector. D4, DIN, ST, RUNGE, SMA, and DIAMOND connectors are also available.

3.6.5 Leaking light detection

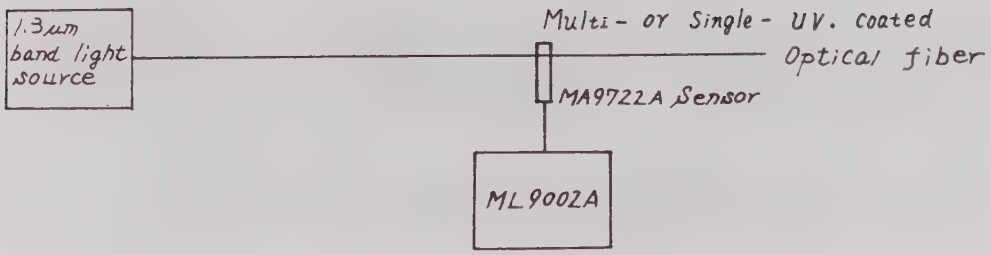


Fig. 3-12 Leaking Light Detection

Step	Procedure
1	Take out the UV coated fiber under test.
2	Fit the UV coated fiber at the place at which the leaking light is to be measured with the MA9722A Optical Power Sensor and measure the leaking light.
3	Set the ML9002A to the buzzer mode, set the buzzer level, and check the optical fiber leaking light.

3.7 Measurement at Other than Calibrated Wavelengths

The responsivity of the optical power sensors is calibrated at three wavelengths (MA9722A: at 1.3 μm only). The absolute value can be directly read by setting wavelength switch #13 to the measurement wavelength. To make accurate measurements at a wavelength other than these three wavelengths, the responsivity of the optical power sensor must be compensated. Make this compensation with 0.85 μm or 1.3 μm as the reference. The typical wavelength-responsivity characteristic of each optical power sensor is shown in Fig. 3-13, Fig. 3-14, and Fig. 3-15.

The MA9421A/MA9422A/MA9423A characteristics are plotted with 0.85 μm as the reference and the MA9621A/MA9721A/MA9722A/MA9723A characteristics are plotted with 1.3 μm as the reference. When making measurements, set wavelength switch #13 to the correct reference wavelength.

For example, when 1 μm is made the measurement wavelength with the MA9423A Optical Power Sensor, the characteristic is -0.3 dB at 1 μm for 0.85 μm. If the value displayed at this time is made -20 dBm, it is compensated by 0.3 dB and becomes -20 dBm - (-0.3 dB) = -19.7 dBm. Therefore, the optical power level is -19.7 dBm at 1 μm.

Similarly, if the value displayed is 0.01 mW at 1 μm measurement wavelength, when compensated by 0.3 dB, 0.0107 mW = 0.01 mW x $10^{(0.3/10)}$ mW.

Therefore, the optical power level is 0.0107 mW at 1 μm.

Note:

dBm = 10 x log (value displayed in mW)

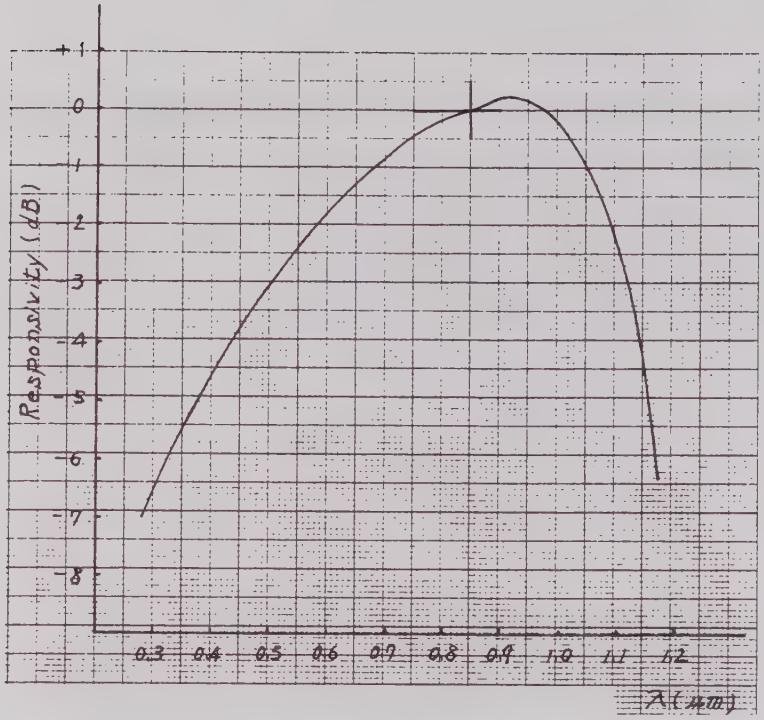


Fig. 3-13 MA9421A/MA9422A/MA9423A Responsivity Characteristics

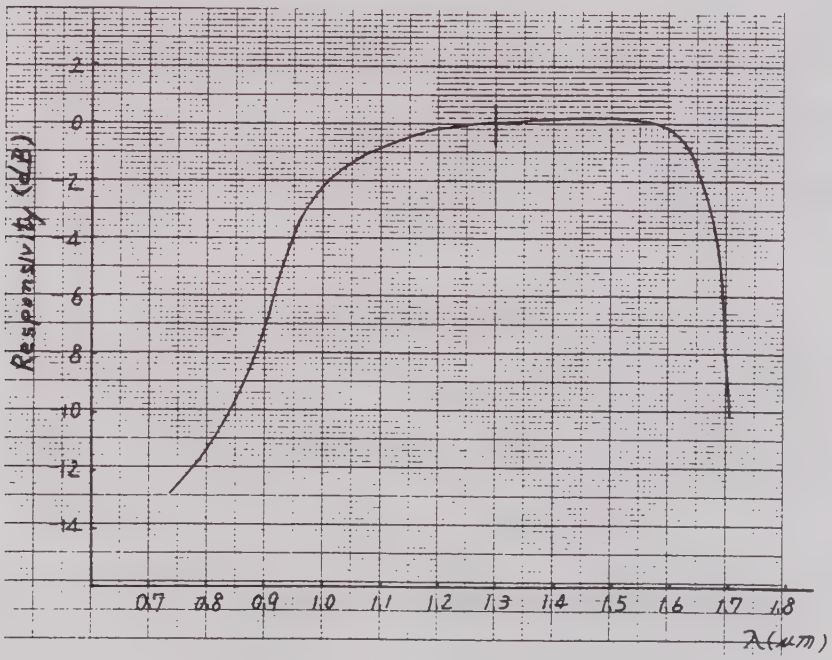


Fig. 3-14 MA9621A Responsivity Characteristics

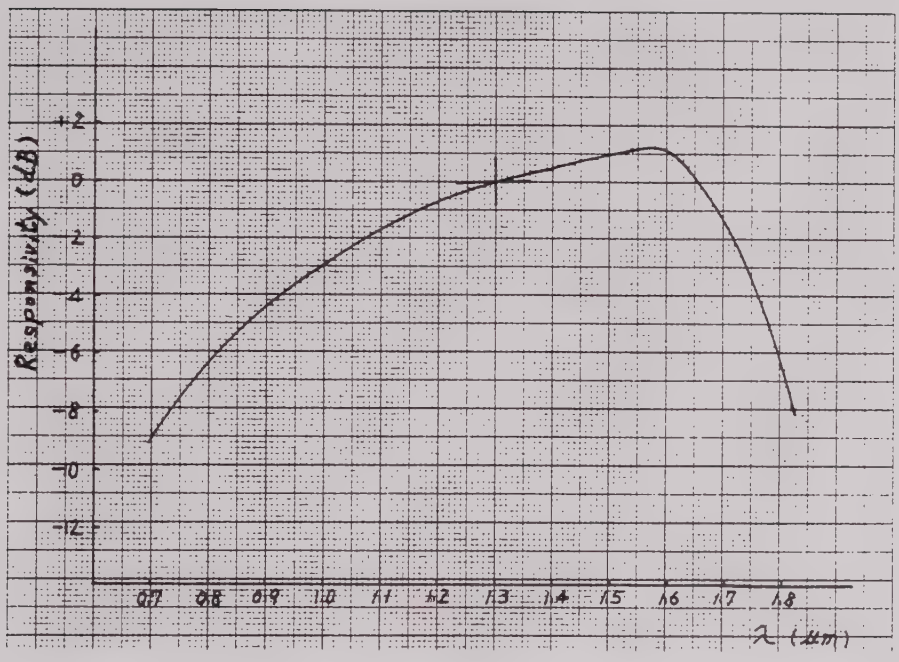


Fig. 3-15 MA9721A/MA9722A/MA9723A Responsivity Characteristics

SECTION 4

PRINCIPLES OF OPERATION

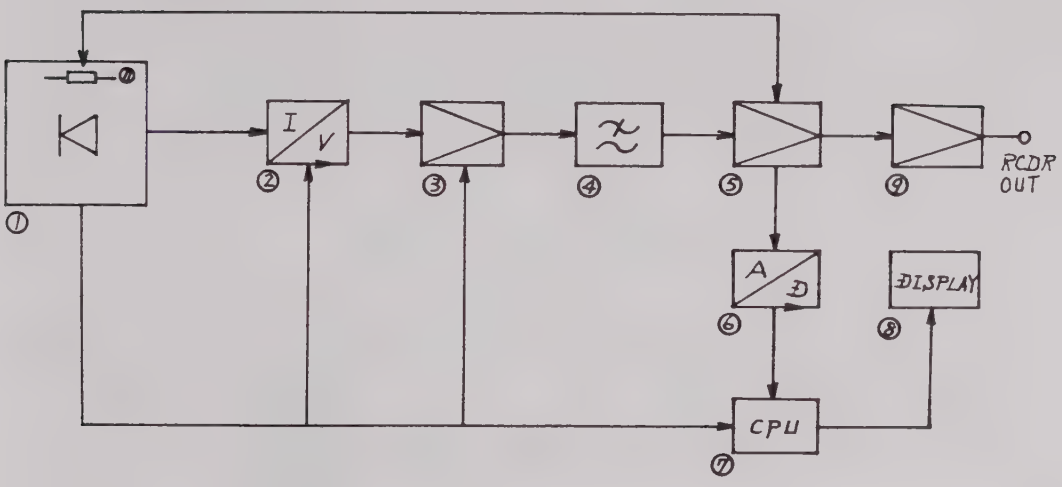


Fig. 4-1 Block Diagram

The MA9421, MA9422A, and MA9423A use a Si photodiode as the photoelectric conversion device; the MA9621A uses an InGaAs photodiode; and the MA9721A, MA9722A, and MA9723A use a Ge photodiode.

The light input to the optical power sensor (1) is photoelectrically converted by a photodiode and is converted to a voltage by a current to voltage converter circuit (2) consisting of an operational amplifier. Next, the signal passes through a variable gain amplifier (3) and an A/D converter (6) for digitalizing, and is input to a CPU (7). After processing by the CPU, the signal is displayed on the LCD at DISPLAY (8).

The optical power sensor (1) has a responsivity compensation resistor for compensating variations in the photodiode detection sensitivity. The overall gain when combined with the ML9002A is constant irrespective of the optical power sensor model.

SECTION 5

PERFORMANCE TEST

5.1 Introduction

The ML9002A test specifications are shown in Table 5-1. The test performance sheets are shown in paragraph 5.5. The specifications apply at 25°C and 63% relative humidity.

Table 5-1 Test Contents

	Test Item	Specifications tested		Test Outline
1.	Wavelength range	MA9421A MA9422A MA9423A	0.38 to 1.15 µm	Measure the wavelength range by using a xenon lamp, monochromator, and reference sensor.
		MA9621A	0.75 to 1.7 µm	
		MA9721A MA9722A MA9723A	0.75 to 1.8 µm	
2.	Power measurement range	MA9421A	-60 to +20 dBm (at 0.85 µm)	Measure the power measurement range by using a reference power meter, light source, and optical attenuator.
		MA9422A	-50 to +20 dBm (at 0.85 µm)	
		MA9423A	-70 to +10 dBm (at 0.85 µm)	
		MA9621A	-70 to +3 dBm (at 1.3 µm)	
		MA9721A	-40 to +10 dBm (at 1.3 µm)	
		MA9723A	-60 to +3 dBm (at 1.3 µm)	
3.	Accuracy	MA9421A MA9422A	±5% (at 0.633/0.78/ 0.85 µm, -10 dBm)	Measure the accuracy by using a standard optical power meter, light source, optical attenuator, and dummy fiber.*
		MA9423A	±5% (at 0.66/0.78/ 0.85 µm, -10 dBm)	
		MA9621A MA9721A MA9723A	±5% (at 0.85/1.3/ 1.55 µm, -10 dBm)	

Table 5-1 Test Contents (Cont'd)

	Test Item	Specifications tested			Test Outline
			Insertion loss	Coupling loss	
4.	Insertion loss Coupling loss (MA9722A)	1.3 μm	<0.2 dB	<57 dB	Measure the insertion loss and coupling loss by using an SM-UV fiber, light source, and optical power meter.
		1.55 μm	<2 dB	<45 dB	
5.	Recorder output	Proportional to indicated power with 1 Vdc corresponding to full scale and 0.316 V to -5 dB, in each range with high-impedance load (>10 kΩ)			Measure the recorder output by using a light source, attenuator, and digital voltmeter.

* Note: Figures 3-13, 3-14 and 3-15 show the wavelength responsivities of the sensors.

5.2 Equipment Required for Performance Test

Table 5-2 lists the equipment required for testing performance. The specifications are the principal parameters required for calibration. The performance of alternative equipment should be checked.

The specifications are valid at 25°C and 63% relative humidity. Dust (0.5 μm) levels should be ≦1 million/1 cu ft.

Table 5-2 Equipment Required for Testing Performance

No.	Name	Major Specifications	Equipment
1	Xenon Lamp	° 15.3 $(mW/ch^2)/10^4$ lux	———
2	Mono-chromator	° Grating area 30 x 30 mm ° Resolution 0.5 nm ° Wavelength repeatability 1 nm	———
3	Reference Power Meter and Sensor	° Reference sensor wavelength characteristic <±0.5 dB ° Indication error ≦±0.1 dB	ML9001A, MA9413A, MA9712A
4	Optical Standard Power Meter	° Accuracy <±2% (at 0.38 to 1.85 μm)	LPM-202 (NIHON KOSHUHA Japan)
5	Dummy Fiber	° Optical loss ≦10 dB ° Numerical aperature 0.11 ±0.03 ° Absolute core diameter 26 ±3 μm	FMC-03 (FUJIKURA Japan)

Table 5-2 Equipment Required for Testing Performance (Cont.)

No.	Name	Major Specifications	Equipment
6	Optical Attenuator	° Wavelength 0.85 μm band ° Maximum attenuation 65 dB Error <±1 dB (at 0, 10, 20 dB steps) <±2 dB (at 30, 40 dB steps) <±2.5 dB (at 50 dB steps) ° Insertion loss ≦3.5 dB	MN95A
7	Optical Attenuator	° Wavelength 1.3 μm band ° Maximum attenuation 65 dB Error <±1 dB (at 0, 10, 20 dB steps) <±2 dB (at 30, 40 dB steps) <±2.5 dB (at 50 dB steps) ° Insertion loss ≦3.5 dB	MN95B
8	Voltmeter (Vdc)	° Measuring range ±1.00000 Vdc ° Accuracy ±(0.01 + 0.005)%	———
9	LD Light Source	° Wavelength 0.85 ±0.01 μm ° Output -3 ±1 dBm ° Short-term stability ≦0.02 dB	———

Table 5-2 Equipment Required for Testing Performance (Cont.)

No.	Name	Major Specifications	Equipment
10	LD Light Source	° Wavelength 1.3 ±0.02 μm ° Output -3 ±1 dBm ° Short-term stability ≦0.02 dB	———
11	LD Light Source	° Wavelength 0.85 ±0.01 μm ° Output >+20 dBm ° Short-term stability ≦0.1 dB	———
12	LD Light Source	° Wavelength 1.3 ±0.02 μm ° Output >+10 dBm ° Short-term stability ≦0.1 dB	———

5.3 Warmup

Step	Procedure
1	Turn on the test ML9002A power.
2	Warm-up the light source for more than 30 minutes until the output power stabilizes.

5.4 Performance Test Procedure

5.4.1 Wavelength range

(1) Specifications

MA9421A/MA9422A/MA9423A: 0.38 to 1.15 µm

MA9621A: 0.75 to 1.7 µm

MA9721A/MA9723A: 0.75 to 1.8 µm

Note:

The MA9722A cannot be tested by the user.

(2) Setup

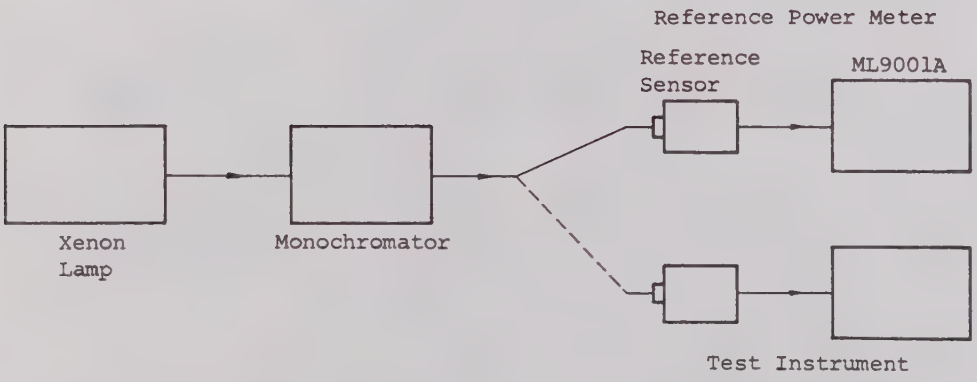


Fig. 5-1 Wavelength Range Test

(3) Procedure

Step	Procedure
1	Connect the monochromator output to the reference sensor.
2	Set the monochromator to 0.38 µm.
3	Read the reference power meter indicator (A).
4	Connect the monochromator output to the test instrument sensor.
5	Read the test instrument indication (B).
6	Calculate the difference between the reference power meter indication and the test instrument indication.
7	Calculate the relative wavelength characteristic (D) at 0.38 µm from the following equation. D (dB) = {C - (A - B)} (dB) Where A: Result of step 3 B: Result of step 5 C: Wavelength characteristic of reference sensor at 0.38 µm (relative sensitivity in which the value at 0.85 µm is reference)
8	Repeat measurement from 0.38 to 1.15 µm or 0.75 to 1.8 µm (or 1.7 µm) in 10 nm steps as described in steps 1 through 7 above. For the MA9421A/MA9422A/MA9423A sensors, the wavelength characteristic at 0.38 to 1.15 µm should be $\geqq$-13 dB. For the MA9621A sensor, the wavelength characteristic at 0.75 to 1.7 µm should be $\geqq$-13 dB. For the MA9721A/MA9723A sensors, the wavelength characteristics at 0.75 to 1.8 µm should be $\geqq$-13 dB.

5.4.2 Power Measurement Range

(1) Specifications

Sensor	Measurement Range
MA9421A	-60 to +20 dBm (at (0.633)/(0.78)/0.85 μm)
MA9422A	-50 to +20 dBm (at (0.633)/(0.78)/0.85 μm)
MA9423A	-70 to +10 dBm (at (0.66)/(0.78)/0.85 μm)
MA9621A	-70 to +3 dBm (at (0.85)/1.3/(1.55 μm)
MA9721A	-40 to +10 dBm (at (0.85)/1.3/(1.55 μm)
MA9723A	-60 to +3 dBm (at (0.85)/1.3/(1.55 μm)

Note:

The MA9722A cannot tested by the user.

(2) Setup

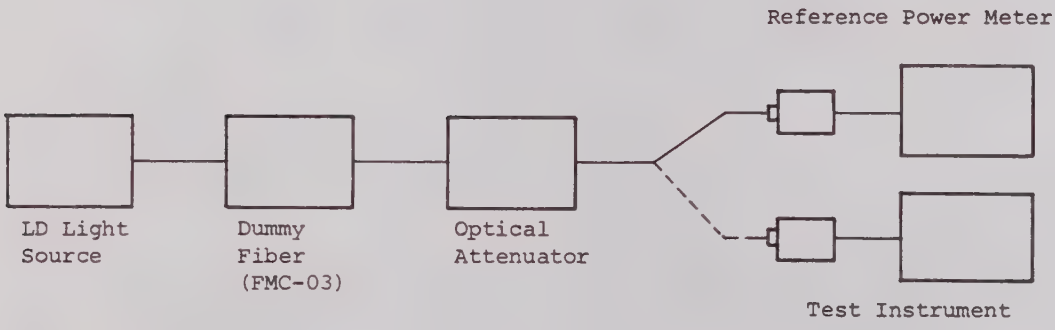


Fig. 5-2 Power Measurement Range Test

(3) Procedure

(a) MA9421A/MA9422A/MA9423A Sensors

Step	Procedure
1	Use the 0.85 μm LD light source.
2	Connect the optical attenuator to the reference power meter sensor.
3	Adjust the optical attenuator to obtain a reference power meter reading of the max. measurement level.
4	Connect the optical attenuator to the test instrument sensor. Read the indication and compare it to the max. measurement level; the difference should be ±0.5 dB or less.
5	Repeat steps 1 through 4 above from (the max. measurement level - 10 dB) to (the min. measurement level + 10 dB) in 10 dB steps.
6	Connect the optical attenuator to the reference power meter sensor and adjust the optical attenuator to give a refernce power meter reading of the min. measurement level.
7	Connect the optical attenuator to the test instrument sensor. Read the indicated value of the test instrument and compare it to the min. measurement level; the difference should be ±1 dB or less.

(b) MA9621A/MA9721A/MA9723A Sensors

Step	Procedure
1	Use the 1.3 μm LD light source.
2	Connect the optical attenuator to the reference sensor.
3	Adjust the optical attenuator to obtain a reference power meter reading of the max. measurement level.
4	Connect the optical attenuator to the test instrument sensor. Read the indication and compare it to the max. measurement level; the difference should be ±0.5 dB or less.
5	Repeat steps 1 through 4 above from 0 dBm to (the min. measurement level + 10 dB) in 10 dB steps.
6	Connect the optical attenuator to the reference sensor and adjust the optical attenuator to indicate the min. measurement level.
7	Connect the optical attenuator to the test instrument sensor. Read the indicated value of the test instrument and compare it to the min. measurement level; the difference should be ±1 dB or less.

5.4.3 Accuracy

(1) Specifications

Sensor	Accuracy
MA9421A MA9422A	±5% (at -10 dBm, 0.633/0.78/0.85 µm, 25°C)
MA9423A	±5% (at -10 dBm, 0.66/0.78/0.85 µm, 25°C)
MA9621A MA9721A MA9723A	±5% (at -10 dBm, 0.85/1.3/1.55 µm, 25°C)

(2) Setup

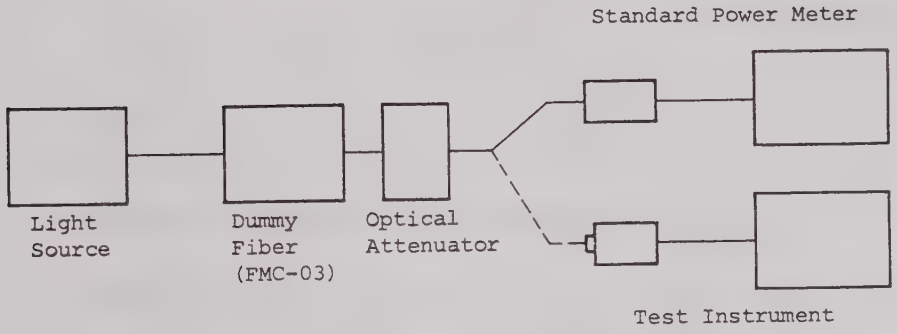


Fig. 5-3 Accuracy Test

(3) Procedure

The standard power meter must be a power meter with an accuracy within 2% of the official standard. The sum of the error with this standard power meter from the official standard and the error with the test instrument from this standard power meter must be within ±5%.

Measurements must be made at an input level of -10 dBm, measurement wavelengths of 0.633 µm, 0.66 µm, 0.78 µm, 0.85 µm, 1.3 µm or 1.55 µm and ambient temperature of 25°C.

MA9421A/MA9422A/MA9423A/MA9621A/MA9721A/MA9723A Sensors

Step	Procedure
1	Use the 0.633 µm, 0.66 µm, 0.78 µm, 0.85 µm, 1.3 µm or 1.55 µm wavelength as the light source.
2	Measurement in a room at an ambient temperature of 25° ±2°C.
3	Connect the optical attenuator to the standard power meter sensor.
4	Adjust the optical attenuator to indicate -10.00 dBm.
5	Connect the optical attenuator to the test instrument sensor MA9421A/MA9422A/MA9423A/MA9621A/ MA9721A/MA9723A and read the indicated value; the reading should be -10.0 ±0.2 dBm.

5.4.4 Insertion loss and coupling loss (MA9722A)

(1) Setup

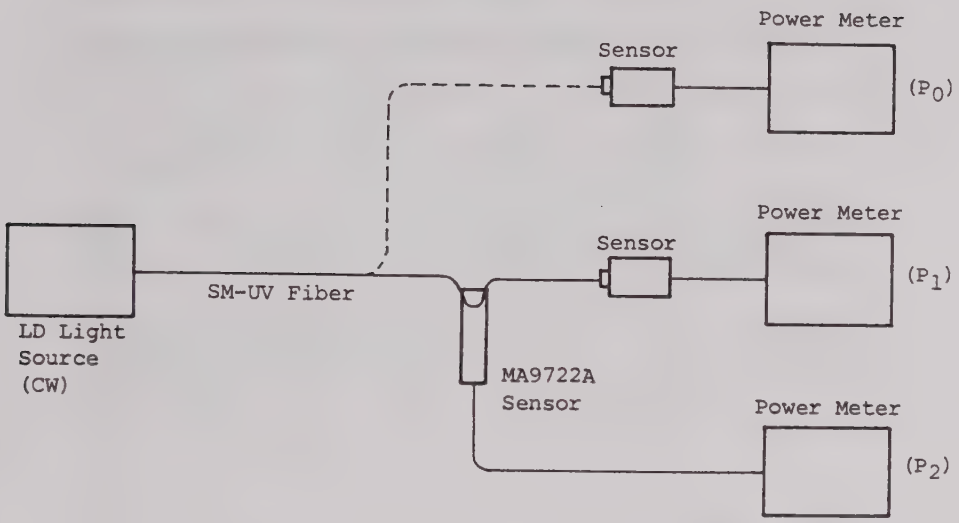


Fig. 5-4 Insertion Loss and Coupling Loss Test

(2) Specification

(a) Insertion loss:

Loss of light propagated in fiber caused by bending fiber

Insertion loss = $P_0 - P_1$ <0.2 dB at 1.3 μm
<2 dB at 1.55 μm

(b) Coupling loss:

Power of light incident to MA9722A caused by bending fiber.

Coupling loss = $P_0 - P_2$ <57 dB at 1.33 μm
<45 dB at 1.55 μm

(3) Procedure

Step	Procedure
1	Connect the SM-UV fiber to the lgiht source (CW).
2	Measure the optical power (P_0) at the output end of the SM-UV fiber while the MA9722A is not connected.
3	Measure the optical power (P_1) at the output end of the SM-UV fiber while the MA9722A is connected.
4	Measure the optical power (P_2) incident to the MA9722A.
5	Calculate the insertion loss and coupling loss, and confirm that they are within the specifications.

5.4.5 Recorder output

(1) Specifications

Proportional to indicated power with +1 Vdc corresponding to full scale and +0.316 Vdc to -5 dB in each range with high-impedance load (>10 kΩ).

(2) Setup

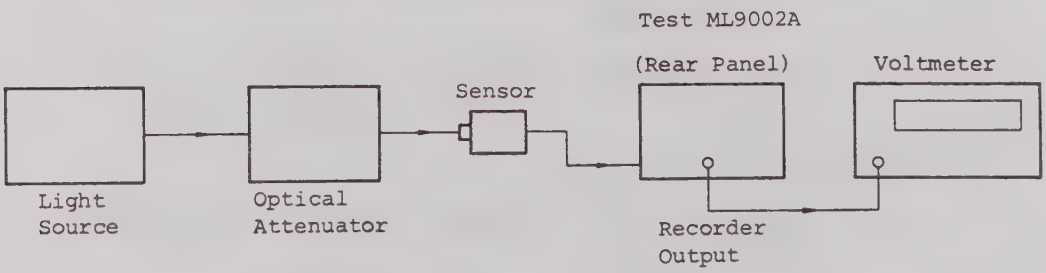


Fig. 5-5 Recorder Output Test

(3) Procedure

Step	Procedure
1	Connect the optical attenuator output to the sensor (MA9421A, MA9422A, MA9423A, MA9621A, MA9721A or MA9723A).
2	Connect the test ML9002A recorder output to a voltmeter.
3	Confirm that, at full scale, the voltmeter meter reading is +1 Vdc ±5% and that when the optical input is decreased by 5 dB (using optical attenuator), the voltmeter reading is +0.316 Vdc ±5%.

5.5 Test Performance Sheet

Date _____

Test No. _____

Operator _____

Temp. _____

Relative humidity _____

Tested by _____

Item 1: Wavelength Range

Specifications

MA9421A/MA9422A/MA9423A:	0.38 to 1.15 µm
MA9621A:	0.75 to 1.7 µm
MA9721A/MA9723A:	0.75 to 1.8 µm

Result (MA9421A/MA9422A/MA9423A)

Wavelength (µm)	Relative Responsivity (dB)
0.633	
0.66	
0.78	
0.85	

Note: 0.85 µm reference wavelength

Result (MA9621A)

Wavelength (µm)	Relative Responsivity (dB)
0.85	
1.3	
1.55	

Note: 1.3 µm reference wavelength

Result (MA9721A/MA9723A)

Wavelength (µm)	Relative Responsivity (dB)
0.85	
1.3	
1.55	

Note: 1.3 µm reference wavelength

Item 2: Power Measurement Range

Specifications

MA9421A:	-60 to +20 dBm (at 0.85 µm)
MA9422A:	-50 to +20 dBm (at 0.85 µm)
MA9423A:	-70 to +10 dBm (at 0.85 µm)
MA9621A:	-70 to +3 dBm (at 1.3 µm)
MA9721A:	-40 to +10 dBm (at 1.3 µm)
MA9723A:	-60 to +3 dBm (at 1.3 µm)

Result

MA9421A

Optical Input (dBm)	Measured Value (dBm)
+20	
+10	
0	
-10	
-20	
-30	
-40	
-50	
-60	

Item 2: Power Measurement Range (Cont.)

MA9422A

Optical Input (dBm)	Measured Value (dBm)
+20	
+10	
0	
-10	
-20	
-30	
-40	
-50	

MA9423A

Optical Input (dBm)	Measured Value (dBm)
+10	
0	
-10	
-20	
-30	
-40	
-50	
-60	
-70	

Item 2: Power Measurement Range (Cont.)

MA9621A

Optical Input (dBm)	Measured Value (dBm)
+3	
0	
-10	
-20	
-30	
-40	
-50	
-60	
-70	

MA9721A

Optical Input (dBm)	Measured Value (dBm)
+10	
0	
-10	
-20	
-30	
-40	

Item 2: Power Measurement Range (Cont.)

MA9423A

Optical Input (dBm)	Measured Value (dBm)
+3	
0	
-10	
-20	
-30	
-40	
-50	
-60	

Item 3: Accuracy

Specification

Sensor	Specification
MA9421A MA9422A MA9423A	±5% (at -10 dBm, 0.85 µm)
MA9621A MA9721A MA9723A	±5% (at -10 dBm, 1.3 µm)

Result

Sensor	Measured Value
MA9421A	
MA9422A	
MA9423A	
MA9621A	
MA9721A	
MA9723A	

Item 4: Insertion loss/Coupling loss

Specifications

MA9722A

Wavelength	Insertion loss	Coupling loss
1.3 µm	<0.2 dB	<57 dB
1.55 µm	<2 dB	<45 dB

Result

MA9722A

Wavelength (µm)	Insertion loss (dB)	Coupling loss (dB)
1.3		
1.55		

Item 5: Recorder Output

Specifications

Proportional to indicated power with +1 Vdc corresponding to full scale and +0.316 Vdc to -5 dB, in each range with high-impedance load (>10 kΩ)

Result

Optical Input	Recorder Output (V)
Full scale, in each range	
5 dB below full scale	

SECTION 6

ADJUSTMENT

6.1 Introduction

This section describes how to carry out preventive maintenance and how to adjust the ML9002A.

Table 6-1 Preventive Maintenance

Problem	Occurrence	Procedure
Dirt	° Before long-term storage	Wipe off with cleaning solvent.
Dust, etc.	° In dusty environment	Blow out with compressed air, etc.
Loose knobs and screws	When found	Retighten with screwdriver, etc.

6.2 Adjustment

6.2.1 Instruments required for adjustment

Table 6-2 Instruments Required for Adjustment

No.	Instrument	Major Specifications	Required for
1	DC voltage standard	Output voltage: 0 to 50 V Resolution : 1 mV	ML9002A (Main unit)
2	Oscilloscope	Frequency range : DC to 50 MHz	ML9002A (Main unit)
3	Digital Volt Meter	Sensitivity : 1 μV Input resistance : 10 MΩ	ML9002A (Main unit)

Table 6-2 Instruments Required for Adjustment (Cont.)

No.	Instrument	Major Specifications		Required for
4	Light source	Output	: >-5 dBm	Optical power sensor
		Wavelength	: 0.633, 0.66, 0.78, 0.85, 1.3, and 1.55 μm	
5	Optical attenuator	Attenuation	: ≧50 dB	Optical power sensor
		Resolution	: 0.01 dB	
6	Optical power meter (ML9002A)	Measuring range	: 0 to -60 dBm	Optical power sensor
		Measuring wavelength	: 0.633, 0.66, 0.78, 0.85, 1.3, and 1.55 μm	

6.3 Adjustment

6.3.1 ML9002A sensitivity adjustment procedure

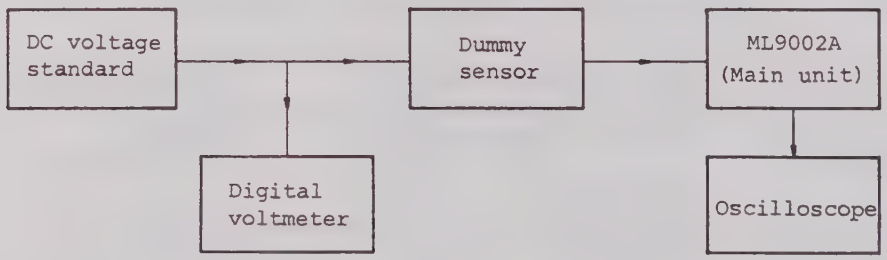


Fig. 6-1 ML9002A (Main Unit) Sensitivity Adjustment

The dummy sensor shown in Fig. 6-1 is a circuit used to provide an input that corresponds to the signal from the optical power sensor to the ML9002A. Figure 6-2 shows the circuit diagram.

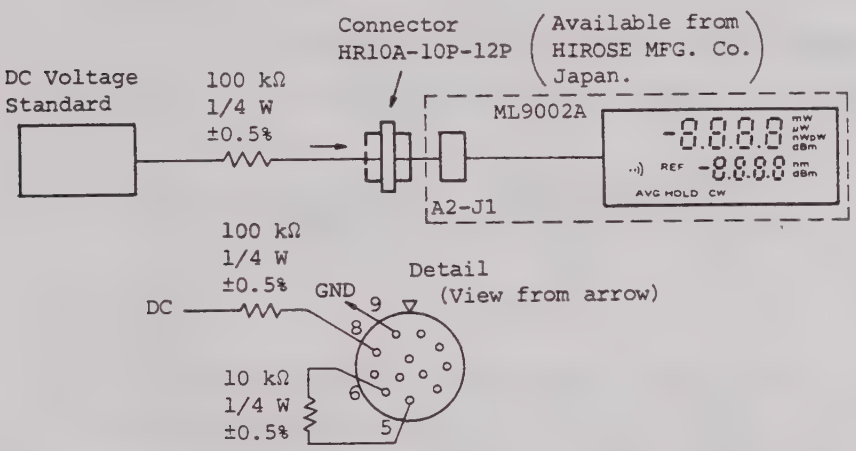


Fig. 6-2 Circuit Diagram of Dummy Sensor

(1) Offset adjustment

Step	Procedure
1	Connect a 10 kΩ/1/4 W/±0.5% resistor between A2-J1-5 and A2-J1-6 and a 1 kΩ/1/4 W/±0.5% resistor between A2-J1-8 and A2-J1-9.
2	Connect the A2-TP1 terminal to analog ground.
3	Set the ML9002A to the W (watts) indication and adjust A2-R8 to indicate 0.00 nW.
4	Remove the wire that connects A2-TP1 to analog ground, and adjust A2-R7 so that the voltage at A2-TP1 is 0 V.

(2) Display full scale adjustment

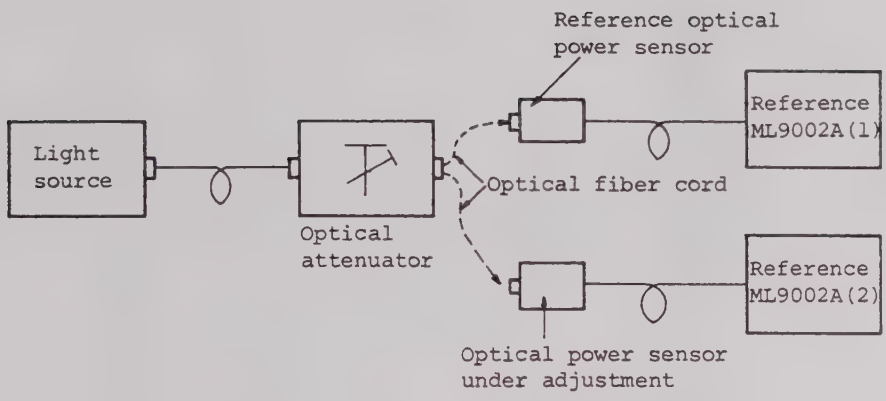
Step	Procedure
1	Set the DC voltage standard output voltage to -5.0 V.
2	Adjust A1-R5 to make the LCD +100.0 μW.

6.3.2 Optical power sensor sensitivity adjustment procedure (MA9421A/9422A/9423A or MA9621A/9721A/9723A)

Step	Procedure
1	As shown in Fig. 6-3, input an optical power with the set wavelength of the sensor to the reference optical power sensor and adjust the optical attenuator so that the ML9002A(1) indicates -10.00 dBm.
2	Input the same optical power as in step 1 to the optical power sensor under adjustment and adjust screws #1, 2, and 3 shown in Figs. 6-4 and 6-5 to make the ML9002A(2) indication -10.00 dBm at each set wavelength.

Note:

The MA9722A cannot be adjusted by the user.



Note:

The ML9002A(1) and ML9002A(2) are adjusted to the same sensitivity.

Fig. 6-3 Optical Power Sensor Sensitivity Adjustment

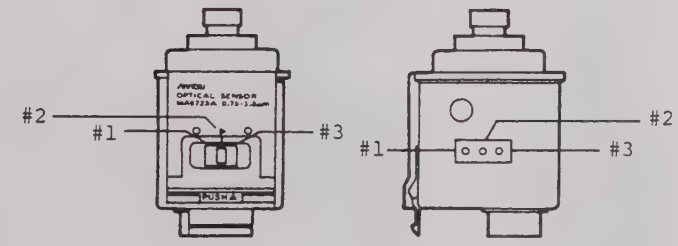


Fig. 6-4 Optical Power Sensors MA9421A/9423A/9621A/ 9721A/9723A

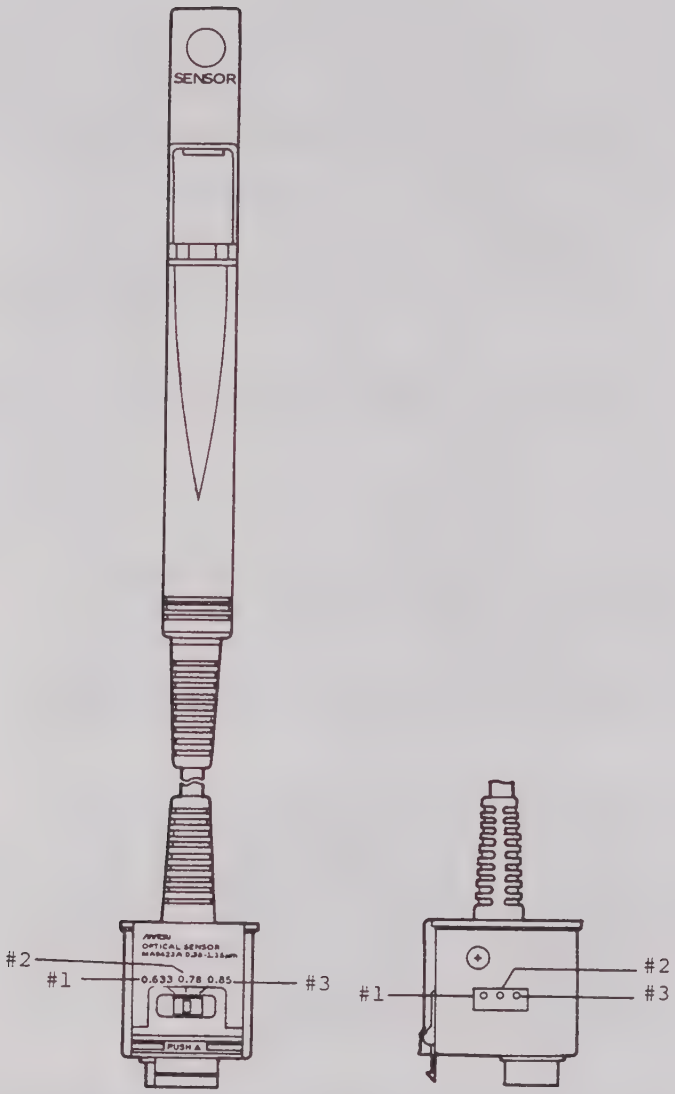


Fig. 6-5 Optical Power Sensor MA9422A

SECTION 7

MECHANICAL CONFIGURATION

7.1 ML9002A Disassembly (Figs. 7-1 and 7-2)

Step	Procedure
1	Remove protection cap #1 (Fig. 7-1).
2	Remove screws #9 and #11.
3	Remove top case #2.
4	Remove PC boards #7 (A1) and #8 (A2).

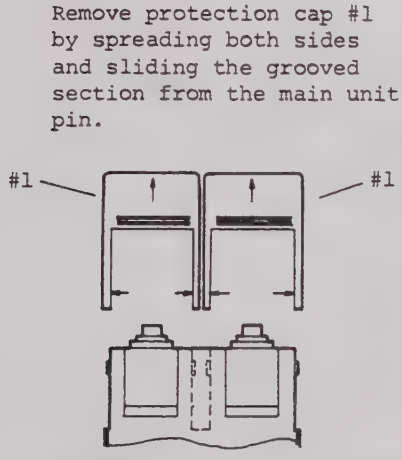


Fig. 7-1 Removing Protection Cap #1

7.2 Mechanical Configuration

Tables 7-1 and 7-2 lists the mechanical parts.

Figure 7-2 shows the ML9002A exploded diagram.

Table 7-1 ML9002A Indicator Mechanical Parts List

No.	Description	Parts No.	Qty.
#1	Protection cap (RIGHT)	W3B5435	2
#2	Top case (LEFT)	W3B5436 W33B5437B	1
#3	Bottom case	W22B1412	1
#4	Z1 Battery	_____	1
#5	Strap	44Z75027	1
#6	Clamp	W4B14106	1
#7	A1 CONTROL PC Board	_____	1
#8	Z2 AMP PC Board	_____	1
#9	Screw	_____	1
#10	Screw	_____	2
#11	Screw	_____	2

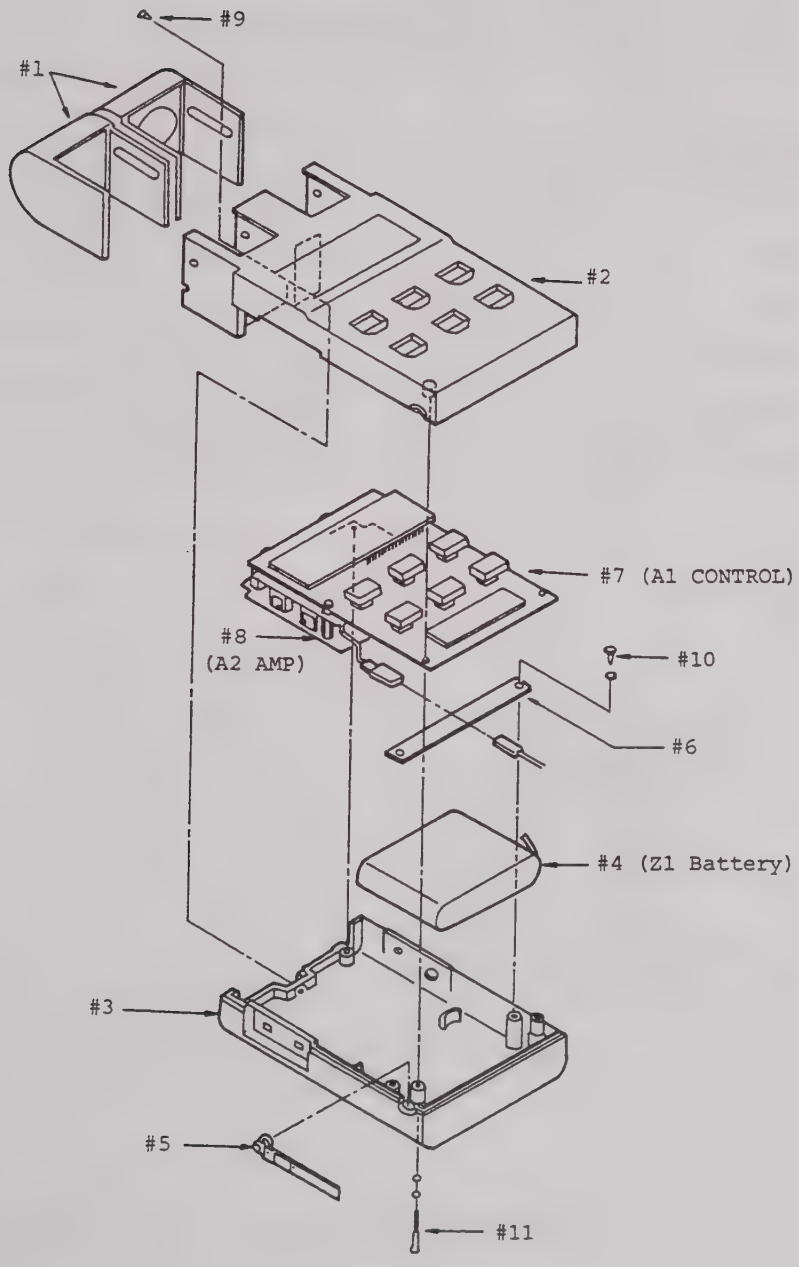


Fig. 7-2 ML9002A Mechanical Configuration

Figure 7-3 shows the ML9002A key top.

Table 7-2 Key Top Mechanical Parts List

No.	Description	Parts No.	Qty.
#12	AVG	W42E14400	1
#13	REL	W42E14400B	1
#14	ABS	W42E14400C	1
#15	SHIFT	W42E14337	1
#16	BUZZER	W42E14400G	1
#17	HOLD	W42E14400F	1

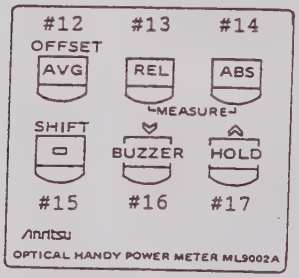


Fig. 7-3 ML9002A Key Top

SECTION 8

TROUBLESHOOTING

8.1 Introduction

If a fault occurs in this instrument, find the faulty part by following the procedure shown in the troubleshooting flowcharts and then make the repair.

8.2 Checking and Replacement of Parts

8.2.1 Explanation of identification markings on PC board

As shown in Fig. 8-1, the ML9002A PC board has a PC board number with revision number, PC board name, and test point name.

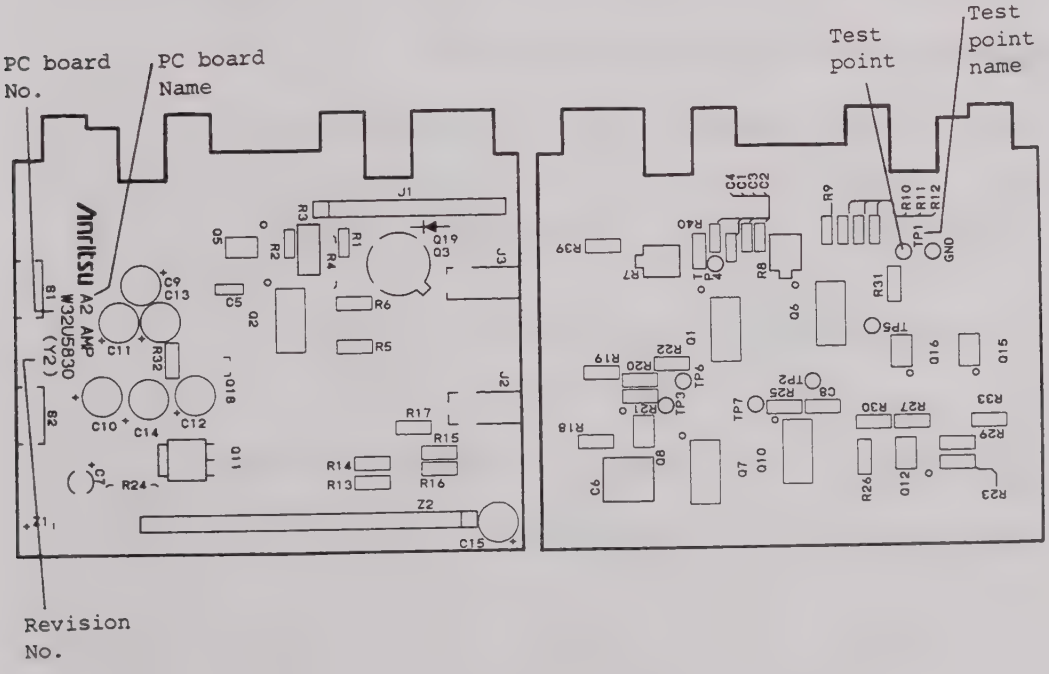


Fig. 8-1 PC Board Identification Markings

8.2.2 Notes on soldering

1. Use an ordinary 30 to 40-watt pencil-type soldering iron.
2. Before using the soldering iron, be sure it is well insulated. If it is not, it may damage the part.
3. When removing a soldered component from a circuit board or soldering in a new component, nip the component lead with tweezers to shunt heat.
4. The tips of major component leads are bent behind the PC board to ensure tight support. To remove a component, first lift up the tips of the leads and then remove the component.

8.3 Instruments Required for Troubleshooting

Table 8-1 Instruments Required for Troubleshooting

No.	Instrument	Major Specifications
1	DC Voltage standard	Output voltage: 0 to 50 V Resolution : 1 mV
2	Oscilloscope	Frequency range: DC to 50 MHz
3	Multimeter	Sensitivity : 1 μV Input resistance: ≧10 MΩ

8.4 Troubleshooting Flowchart

. Before following the troubleshooting flowchart, be sure to measure the DC power supply voltages at TP4, 5, 6, and 7 on the A2 AMP PC board, and make sure that they are as specified in Table 8-2.

Table 8-2 DC Power Supply Voltage

Test point	Supply voltage (V)
TP4	>+5.1
TP5	<-6.0
TP6	>+5.4
TP7	<-4.1

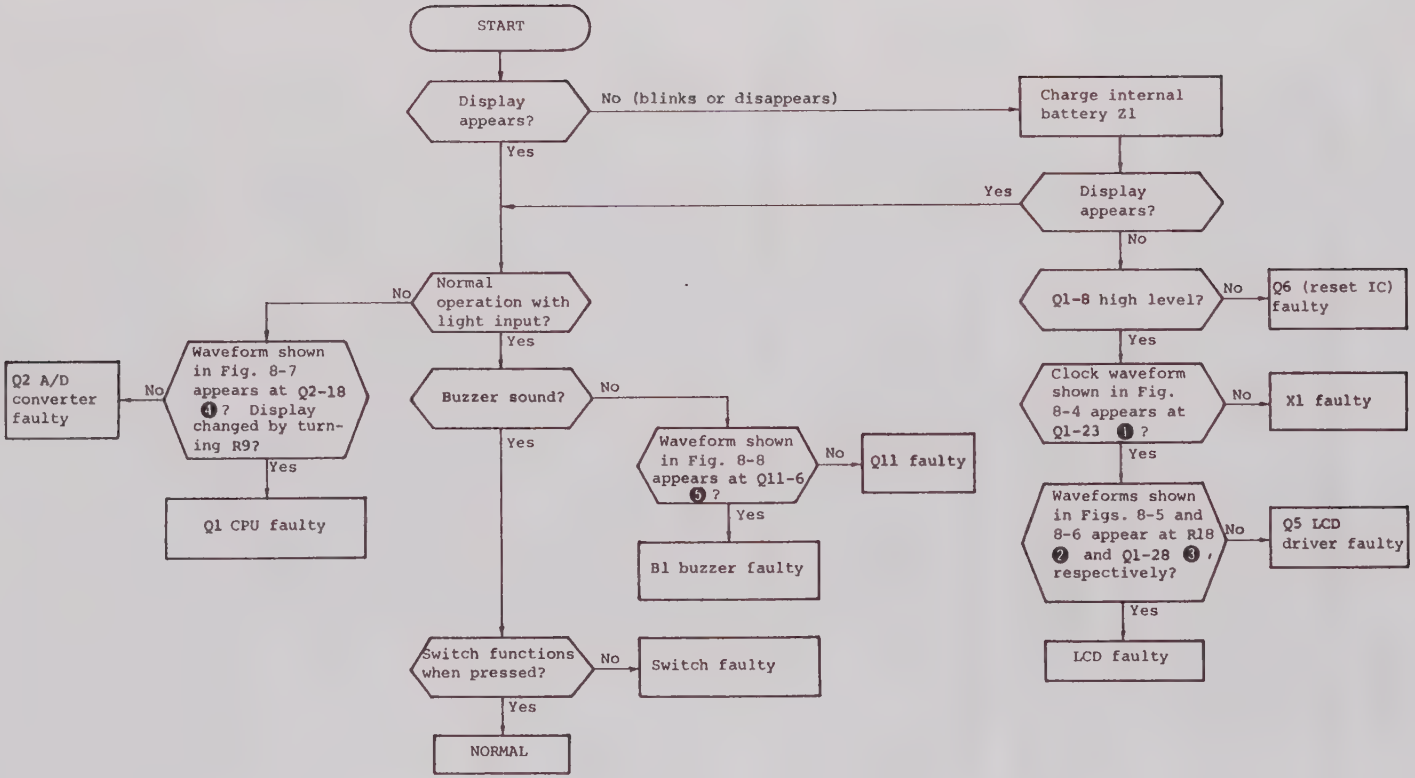


Fig. 8-2 A1 CONTROL PC Board 2 Troubleshooting Flowchart

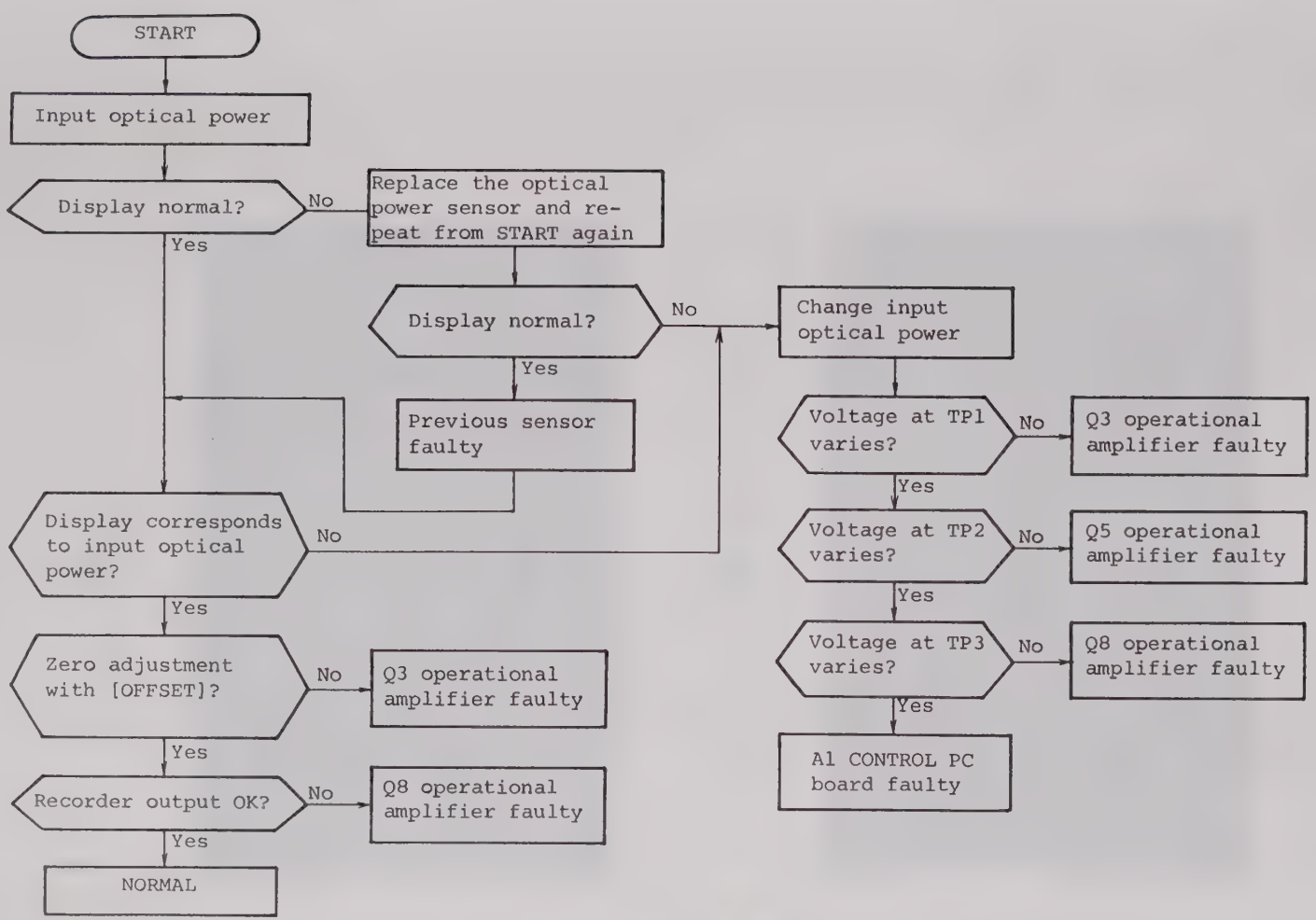


Fig. 8-3 A2 AMP PC Board 3 Troubleshooting Flowchart

Fig. 8-4 ❶ A1-Q4-2

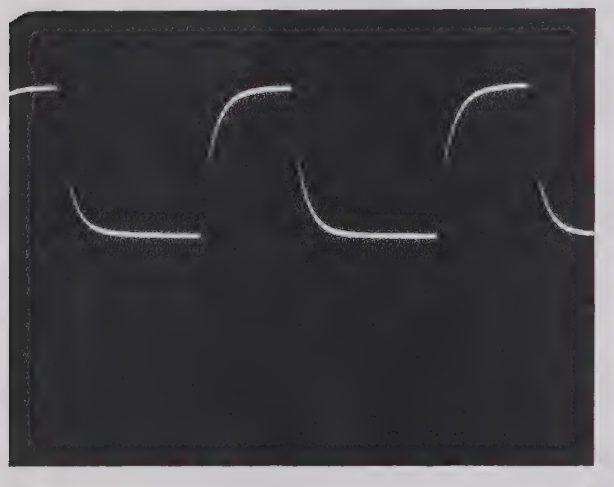


Fig. 8-5 ❷ A1-R18

Fig. 8-6 ❸ Al-Q4-28

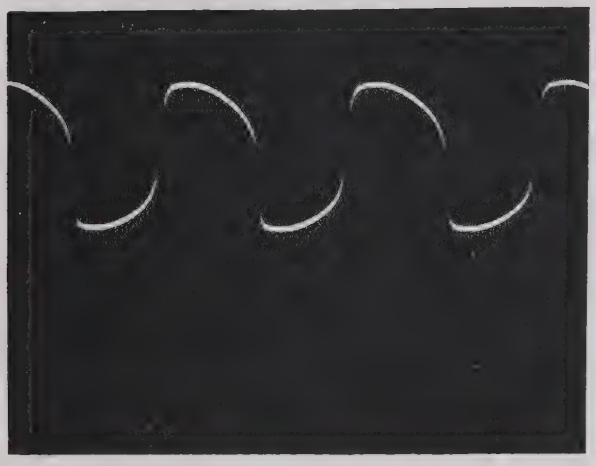


Fig. 8-7 ❹ Al-Ql-18

Fig. 8-8 ❺ Al-Rl6

8.5 Circuit Diagram and PC Board Layout

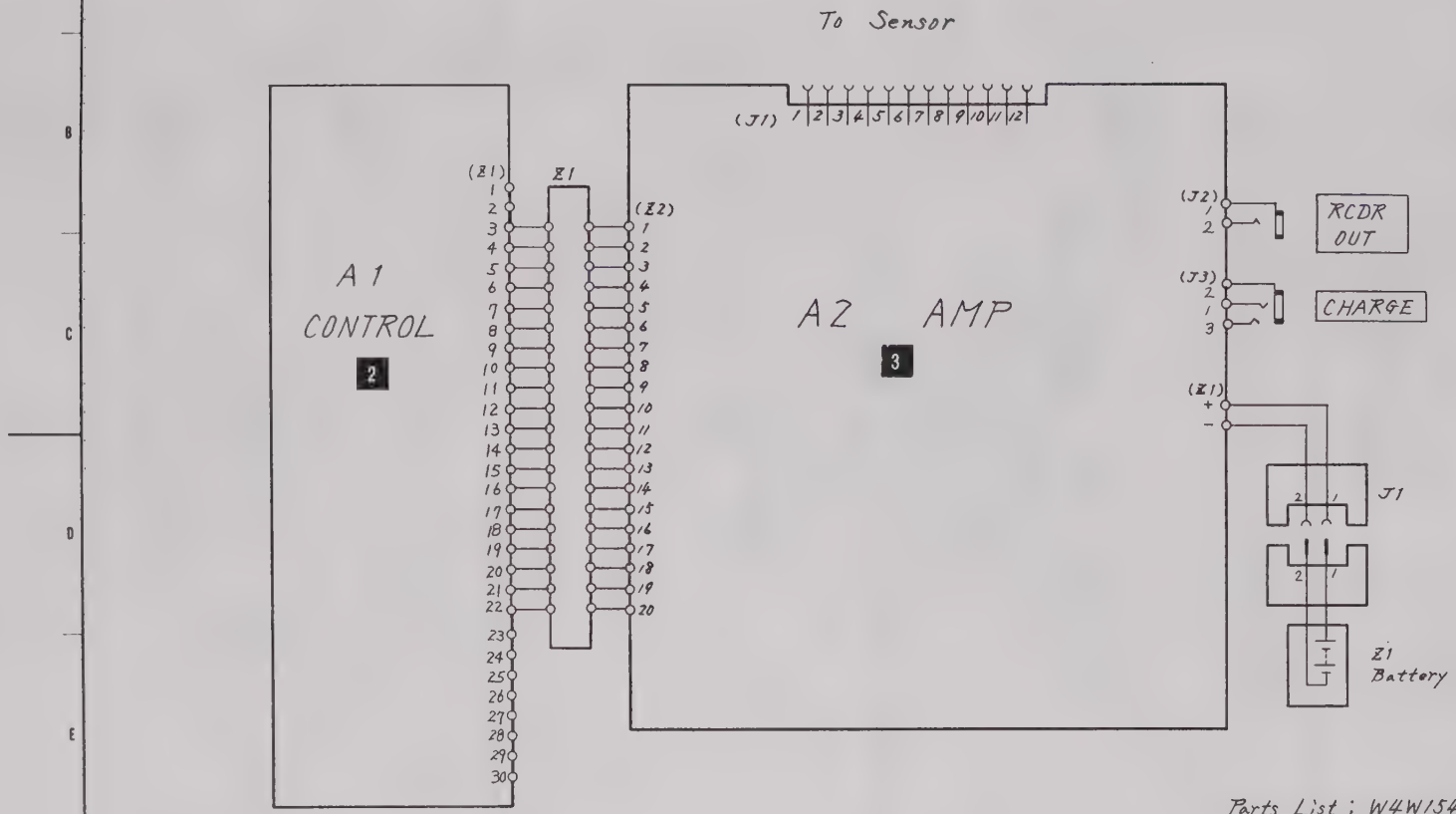
Table 8-3 Circuit References

Schematic No.	A No.	Name	PC Board No.	Parts List No.
1	——	ML9002A	————	W4W15414
2	A1	CONTROL	W32U7842	W4W21307
3	A2	AMP	W32U5830	W4W15416
4	——	MA9421A	W32U14205	W4W13528
5	——	MA9422A	W32U14205	W4W13526
6	——	MA9423A	W32U14205	W4W13524
7	——	MA9621A	W32U14205	W4W13532
8	——	MA9721A	W32U14205	W4W13530
9	——	MA9722A	W32U14205	W4W13536
10	——	MA9723A	W32U14205	W4W13534

W3 W5797 1/1

APPLICATION

REVISIONS



Parts List : W4W15414

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH

CHECKED BY

TRACED BY

SCALE

APPROVED BY S. Fukaya

DRAWN BY T. Ozaki

M-2

TITLE ML900ZA Circuit Diagram.

DRAWING No. W3 W5797 1/1

DEP

0023-1985.08

ANRITSU CORP.

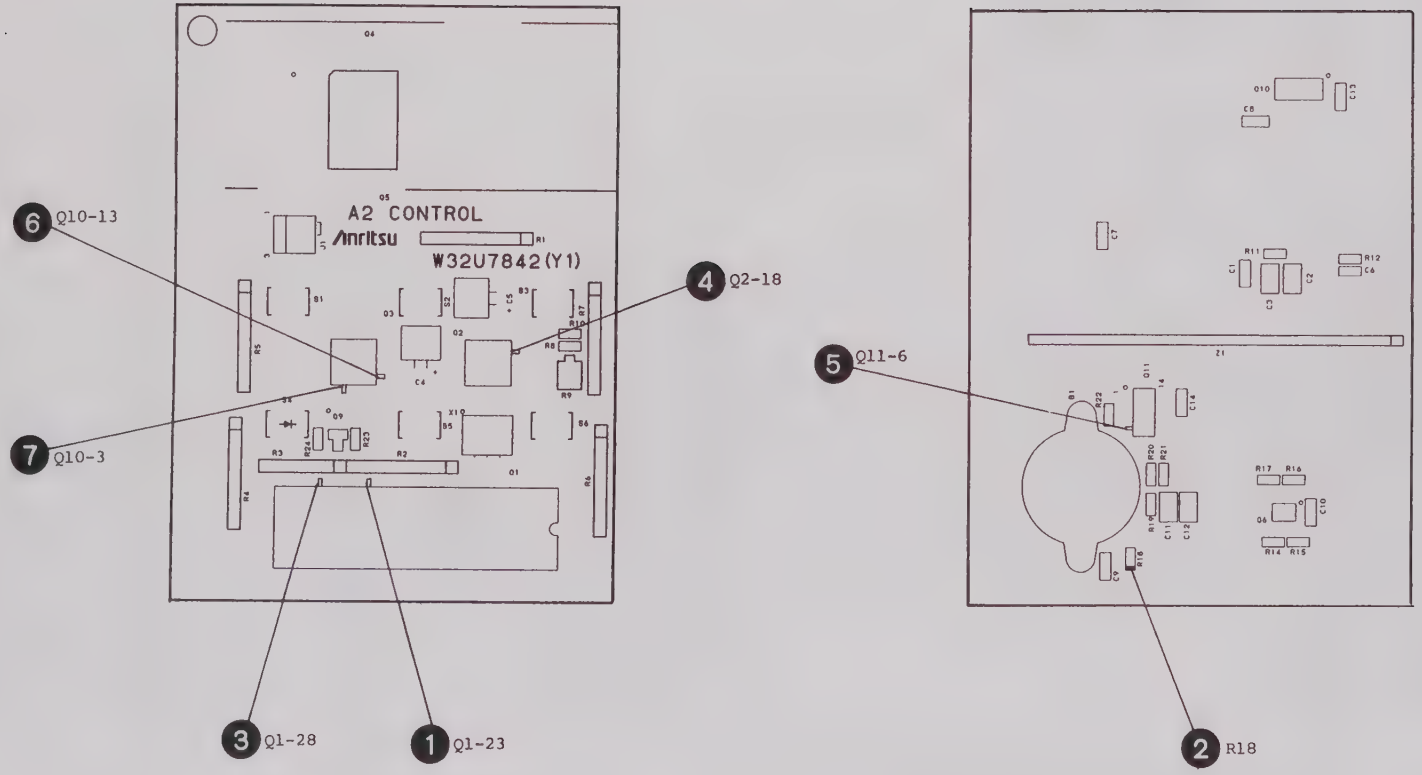
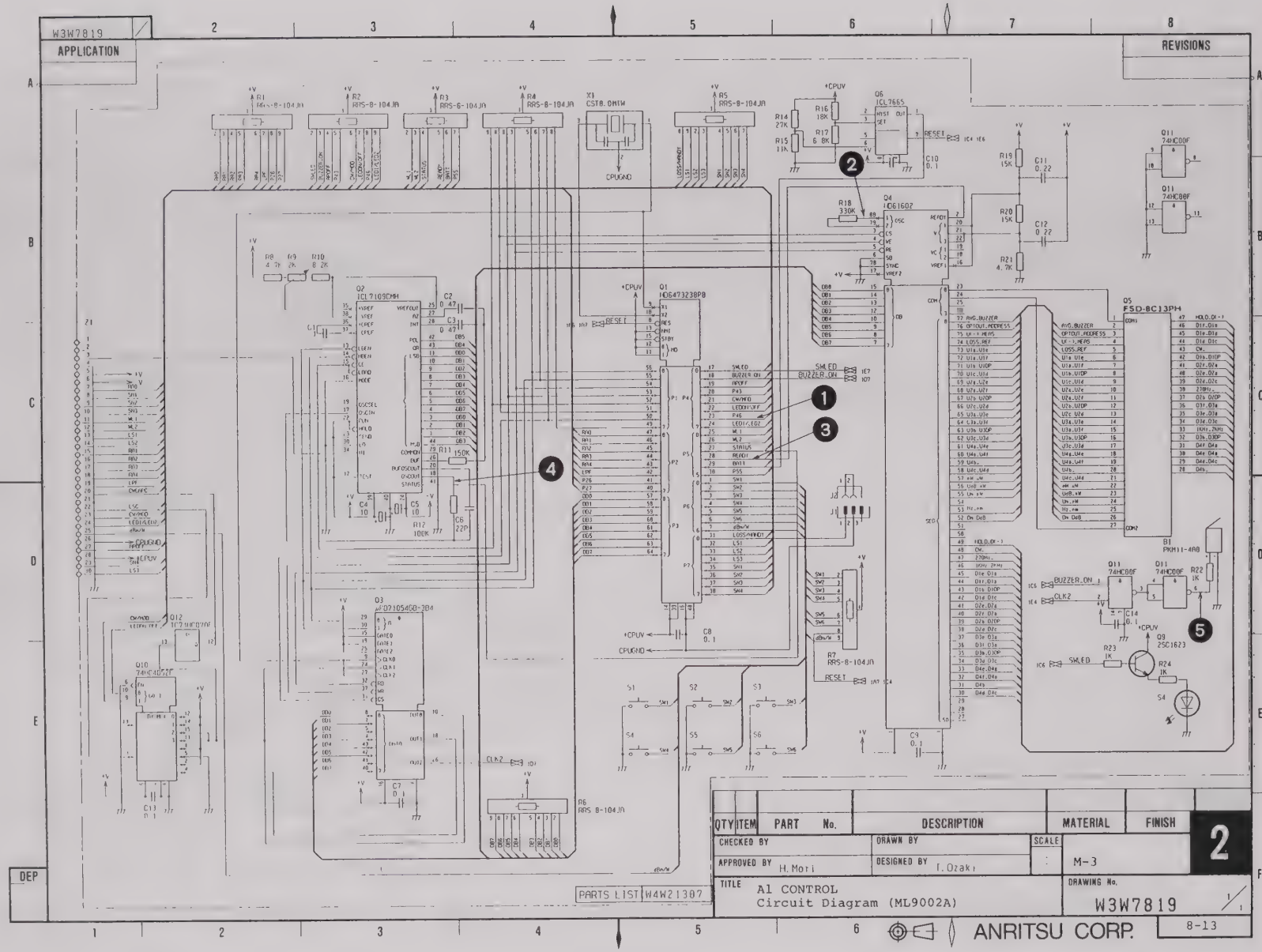
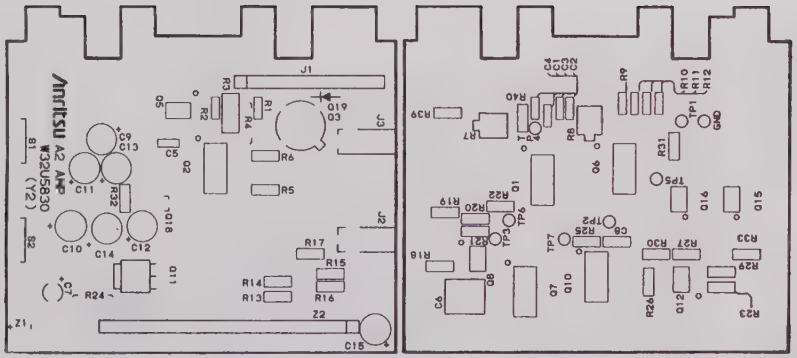


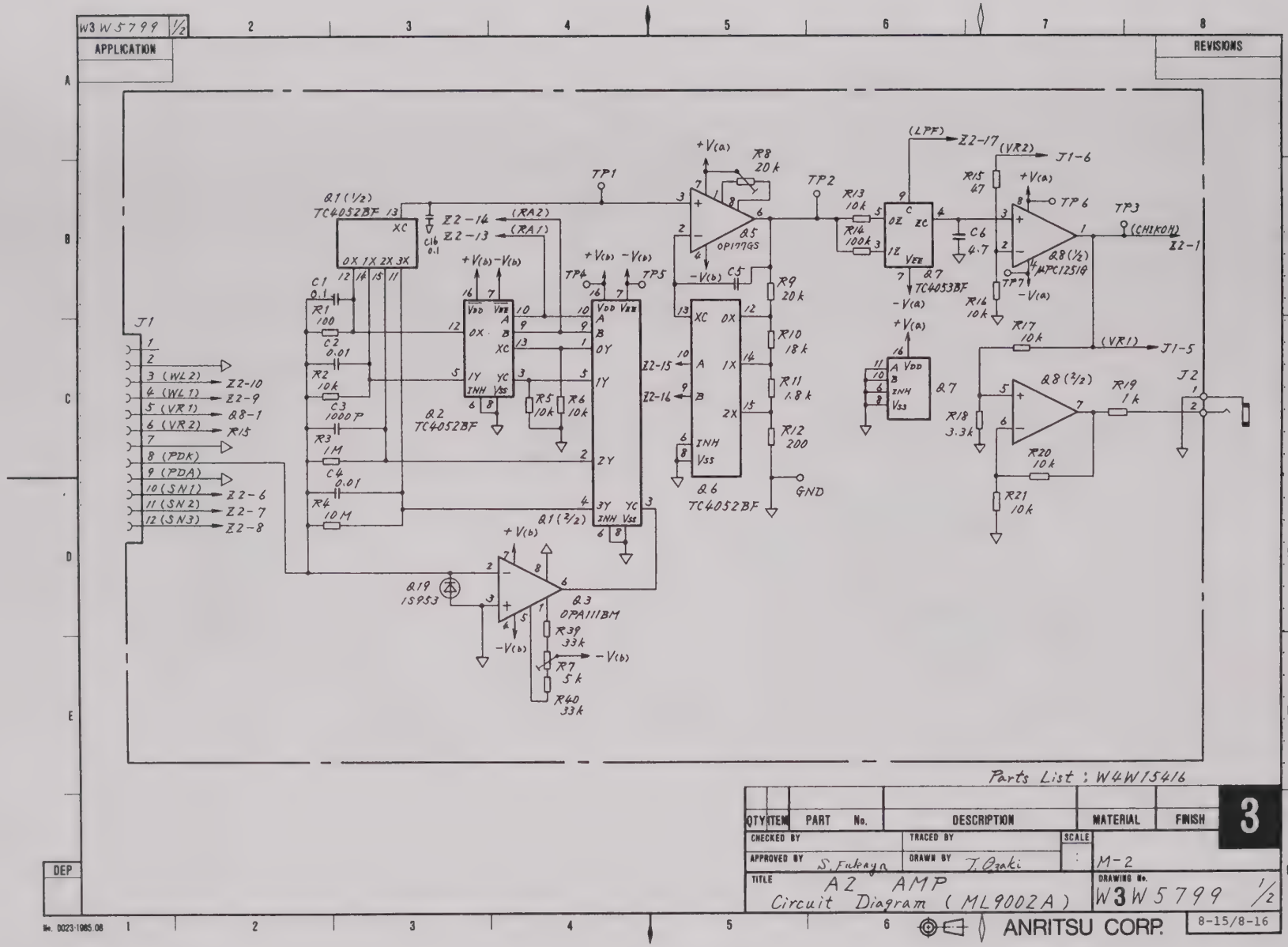
Fig. 8-9 A1 CONTROL PC Board
Parts Layout 2


W3W7819
APPLICATION
REVISIONS
DEP
PARTS LIST W4W21307
QTY ITEM PART No. DESCRIPTION MATERIAL FINISH
CHECKED BY
DRAWN BY
APPROVED BY H.Mori
DESIGNED BY T.Ozaki
SCALE M-3
TITLE Al CONTROL
Circuit Diagram (ML9002A)
DRAWING No. W3W7819
ANRITSU CORP.
8-13



(Parts Side) (Pattern Side)

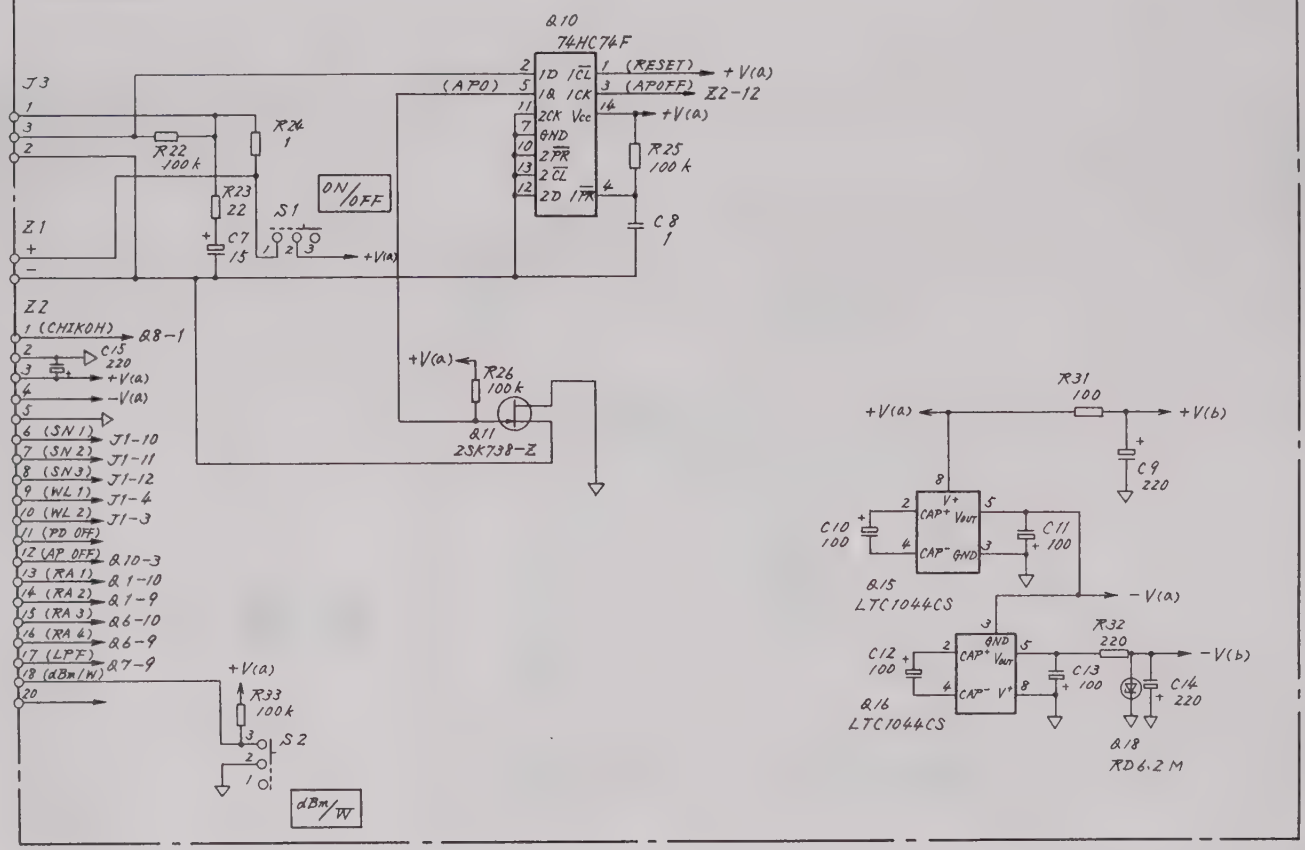
Fig. 8-10 A2 AMP PC Board Parts Layout 3


W3W5799 1/2
APPLICATION
REVISIONS
J1
Z2-10
Z2-9
Z2-6
Z2-7
Z2-8
Q1 (1/2) TC4052BF
Q1 (2/2)
Q2 TC4052BF
Q3 OPA111BM
Q5 OP177GS
Q6 TC4052BF
Q7 TC4053BF
Q8 (1/2) MPC1251G
Q8 (2/2)
Q19 1S953
TP1
TP2
TP3
TP4
TP5
TP6
TP7
(CHIKON)
Z2-1
(RA2)
(RA1)
Z2-14
Z2-13
Z2-15
Z2-16
(LPF)
Z2-17
(VR2)
J1-6
(VR1)
J1-5
+V(a)
-V(a)
+V(b)
-V(b)
GND
R1 100
R2 10k
R3 1M
R4 10M
R5 10k
R6 10k
R7 5k
R8 20k
R9 20k
R10 18k
R11 1.8k
R12 200
R13 10k
R14 100k
R15 47
R16 10k
R17 10k
R18 3.3k
R19 1k
R20 10k
R21 10k
R39 33k
R40 33k
C1 0.1
C2 0.01
C3 1000P
C4 0.01
C5
C6 4.7
C16 0.1
Parts List : W4W1541G
QTY ITEM PART No. DESCRIPTION MATERIAL FINISH
CHECKED BY
APPROVED BY S. Fukaya
TRACED BY
DRAWN BY T. Ozaki
SCALE M-2
TITLE AZ AMP Circuit Diagram (ML9002A)
DRAWING No. W3W5799 1/2
DEP
3
ANRITSU CORP.
8-15/8-16

W3 W5799 2/2

APPLICATION

REVISIONS



QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH

CHECKED BY

APPROVED BY S. Fukuyu

TRACED BY

DRAWN BY T. Ozaki

SCALE : M-2

TITLE AZ AMP Circuit Diagram (ML9002A)

DRAWING No. W3W5799 2/2

DEP

No. 0023-1986 06

ANRITSU CORP.

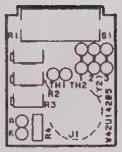


Fig. 8-11 Sensor PC Board Parts Layout 4 to 10

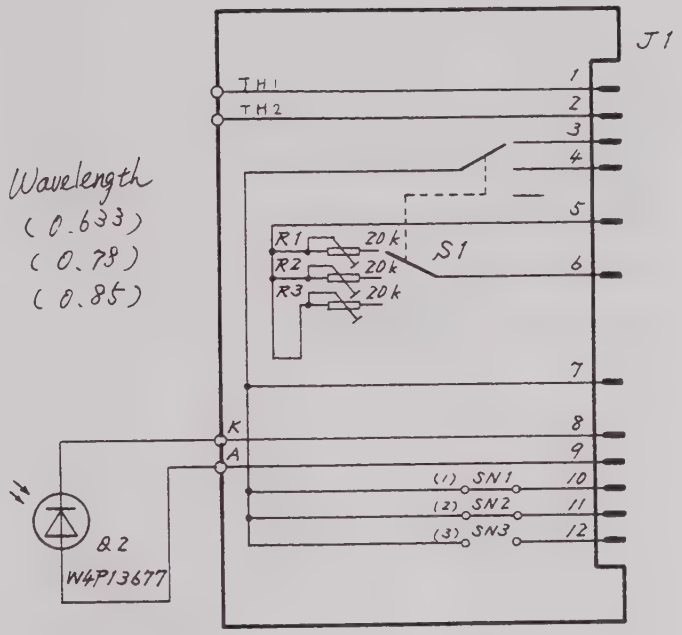
Note:

Common to all sensors

W4W13529 1/1

APPLICATION

REVISIONS



Parts List; W4W13528

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH

4

CHECKED BY | TRACED BY | SCALE M-1

APPROVED BY S. Fukaya | DRAWN BY T. Izaki

DEP

TITLE MA9421A Circuit Diagram.

DRAWING No W4W13529 1/1

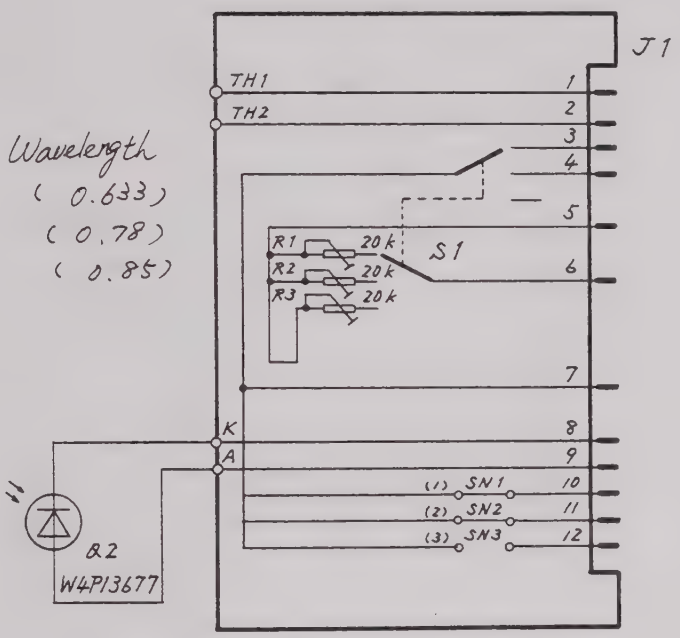
No. DC25 1985.08

ANRITSU CORP.

8-19/8-20

W4W13527 1/1

APPLICATION	REVISIONS



Wavelength
(0.633)
(0.78)
(0.85)

Parts List ; W4W13526

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH

5

CHECKED BY	TRACED BY	SCALE
APPROVED BY S.Fukaya	DRAWN BY T.Ozaki	M-1

DEP

TITLE: MA9422A Circuit Diagram.

DRAWING No: W4W13527 1/1

No D025-1985 08

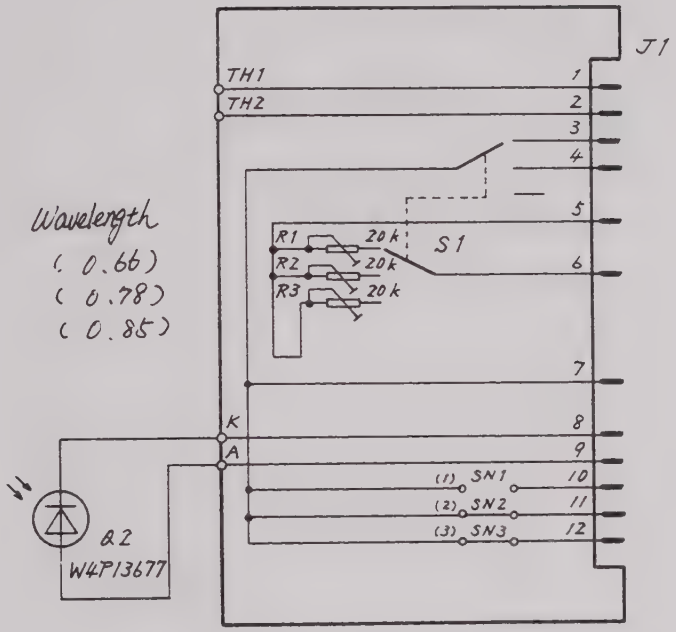
ANRITSU CORP.

8-21/8-22

W4W13525 1/1

APPLICATION

REVISIONS



Wavelength
(0.66)
(0.78)
(0.85)

Parts List : W4W13524

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH
					6

CHECKED BY | TRACED BY | SCALE M-1

APPROVED BY S. Fukaya | DRAWN BY T. Ozaki

DEP

TITLE: MA9423A Circuit Diagram.

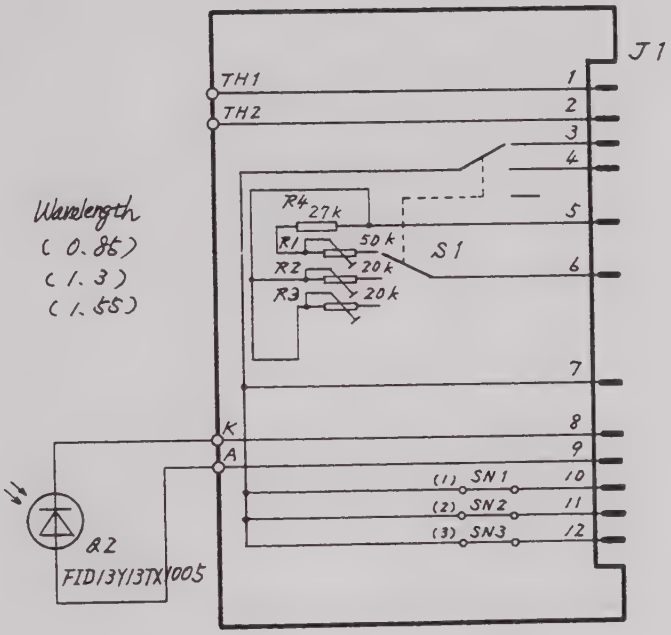
DRAWING No. W4W13525 1/1

ANRITSU CORP. 8-23/8-24

W4 W13533 1/1

APPLICATION

REVISIONS



Parts List : W4W13532

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH

7

CHECKED BY | TRACED BY | SCALE

APPROVED BY S. Fukaya | DRAWN BY J. Ozaki | M-3

DEP

TITLE: MA9621A Circuit Diagram.

DRAWING No. W4 W13533 1/1

ANRITSU CORP.

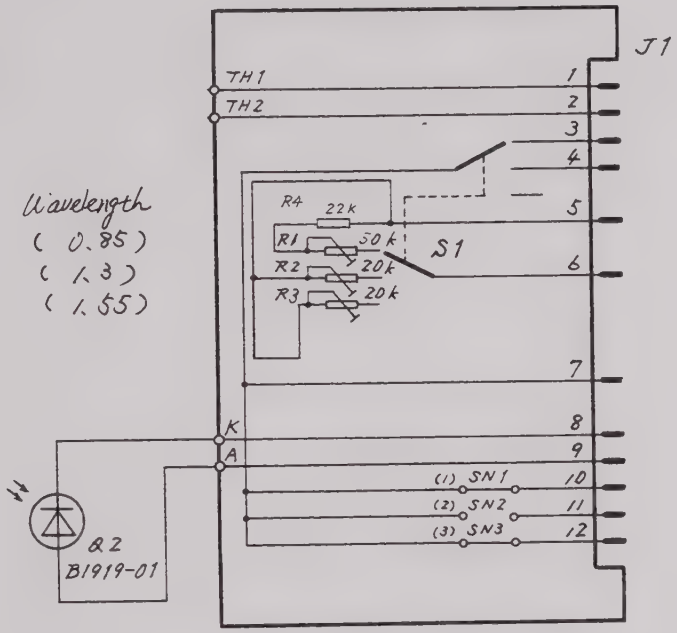
8-25/8-26

D025-1985.08

W4W13531 1/1

APPLICATION

REVISIONS



Parts List : W4W13530

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH

8

CHECKED BY | TRACED BY | SCALE

APPROVED BY S. Fukaya | DRAWN BY T Ozaki | M-3

DEP

TITLE: MA9721A Circuit Diagram.

DRAWING No. W4W13531 1/1

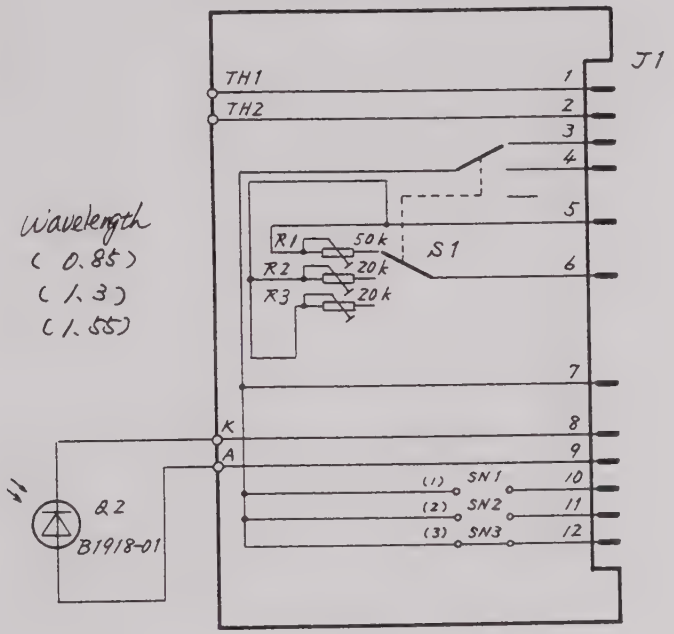
ANRITSU CORP. 8-27/8-28

No 0025-1985.08

W4W13537 1/1

APPLICATION

REVISIONS



Wavelength
(0.85)
(1.3)
(1.55)

Parts List ; W4W13536

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH

9

CHECKED BY | TRACED BY | SCALE

APPROVED BY S. Fukaya | DRAWN BY T. Ozaki | M-2

DEP

TITLE: MA9722A Circuit Diagram

DRAWING No: W4W13537 1/1

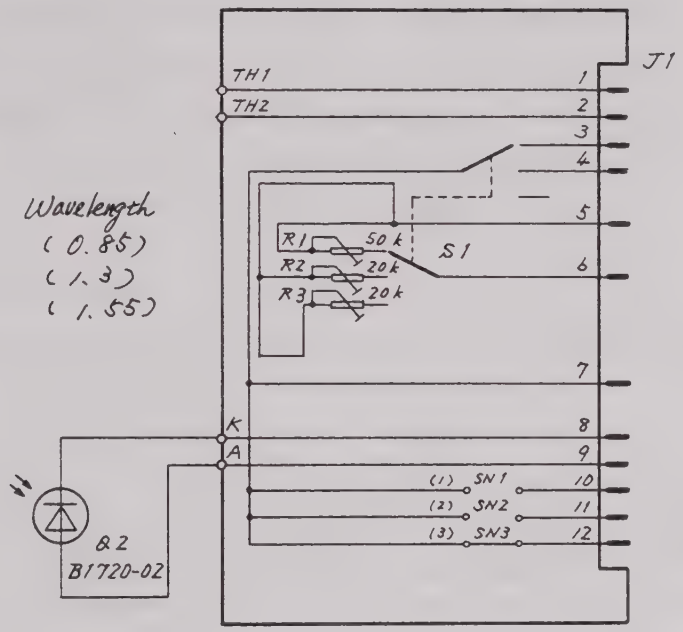
No D025-1985 08

ANRITSU CORP.

8-29/8-30

W4 W13535 1/1

APPLICATION	REVISIONS



Parts List ; W4W13534

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH

10

CHECKED BY	TRACED BY	SCALE
APPROVED BY S. Fukuya	DRAWN BY T. Ozaki	M – 2

DEP

TITLE: MA9723A Circuit Diagram

DRAWING No. W4 W13535 1/1

No 0025-1985 08

ANRITSU CORP.

8-31/8-32

SECTION 9

REPLACEABLE PARTS

9.1 Introduction

This section describes how to order replacement parts.

The following table shows the circuit reference (CKT REF) and abbreviations used for parts in the Parts List.

In the Parts List, the quantity of each part is one if no value is given in the "NOTE" column.

9.2 Ordering Information

When ordering parts, please give the following descriptions by referring to the Parts List.

	Item	Example
(1)	Name of instrument	Optical Handy Power Meter ML9002A
(2)	Name of parts list	Parts of A1 CONTROL (ML9002A)
(3)	CKT REF	B1
(4)	Name of part	Buzzer (EAF-12RT04CC) Note: The parts name is given in parentheses ( ) in the Parts List. Parts with an asterisk* require factory adjustment upon repair. When ordering a part or parts with an asterisk, give a full description of the part.
(5)	Quantity	1
(6)	Serial No. of instrument	Serial No. M31257

When ordering a PC board with parts mounted, please include the A number under item (2) on the previous page instead of item (3) and (4). (See Table 8-3 for PC board number.)

(1) Circuit references

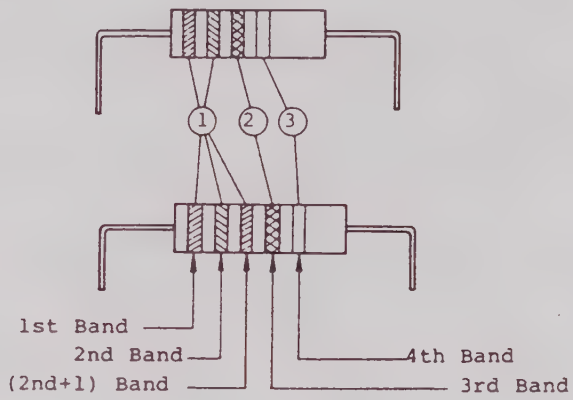
AT:	Attenuator	K:	Relay	Q:	Transistor, diode, IC, rectifier	V:	Neon lamp, vacuum tube
C:	Capacitor	L:	Coil, microinductor	R:	Resistor	X:	Crystal OSC
F:	Fuse	M:	Meter, timer	S:	Switch	Z:	Unit
J:	Jack, plug, connector	P:	Lamp	T:	Transformer		

(2) Abbreviations

A:	amperes	Multi:	multiplying
Att, R var:	variable attenuator using film elements	N-ch:	N-channel
		non-lin:	non-linear taper
BL:	boundary layer	Non-pol:	non polarity
Cer:	ceramic	NPN:	negative-positive-negative
CF:	carbon film	Ω:	ohms
Comp:	composition	p:	pico (x 10^{-12})
CRT:	cathode-ray tube	Plast:	plastic film
Di:	diode	PMTR:	potentiometer
DIP:	dual in-line package	PNP:	positive-negative-positive
Elect:	electrolytic aluminum	p-p:	peak-to-peak value
F:	farad	RFC:	RF choke
FET:	field-effect transistor	R-lamp:	resistor lamp
G:	ground	rms:	effective value (root-mean-square)
Ge:	germanium	SBD:	Schottky barrier diode
H:	henry	SCR:	silicon-controlled rectifier
Hz:	hertz	Si:	silicon
IC:	integrated circuit	SRD:	step-recovery diode
IEC:	Conforms to IEC Safety Standards.	Tant:	tantalum
J-FET:	junction FET	TM:	time-lag
k:	kilo (x 10^{3})	Tr:	transistor
LED:	light-emitting diode	Trans:	transformer
M:	mega (x 10^{6})	μ:	micro (x 10^{-6})
m:	milli (x 10^{-3})	V:	volt
MF:	metallized film	Var:	variable
MOS-FET:	metal-oxide semiconductor FET	WW:	wire-wound
M paper:	metallized paper	XTAL:	crystal
M plast:	metallized plastic film		

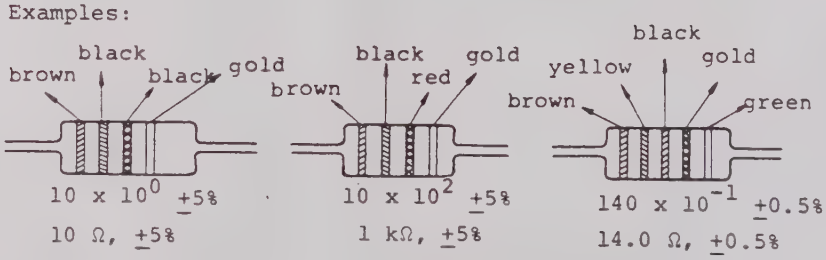
9.3 Reading Capacitance and Resistance

(1) Reading resistance

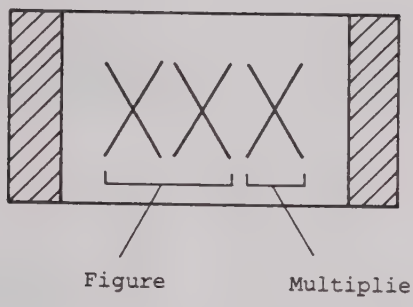


	①		②	③
COLOR	Figure		Multiplier	Tolerance
	1st	2nd	3rd	4th
Black	0	0	$x10^0$	-
Brown	1	1	$x10^1$	-
Red	2	2	$x10^2$	-
Orange	3	3	$x10^3$	-
Yellow	4	4	$x10^4$	-
Green	5	5	$x10^5$	±0.5%
Blue	6	6	$x10^6$	-
Purple	7	7	$x10^7$	-
Gray	8	8	$x10^8$	-
White	9	9	$x10^9$	-
Gold	-	-	$x10^{-1}$	±5%
Silver	-	-	$x10^{-2}$	±10%
-----	-	-		±20%

Examples:



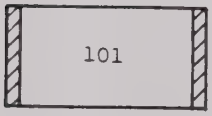
(2) Reading chip resistance



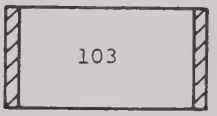
The first two characters are significant digits and the last numeric character indicates the number of zeros that follow the first two characters.

A decimal point is represented by the character R, and numeric characters are all significant digital in the R representation.

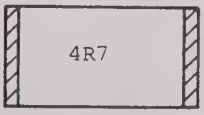
Examples:



100 Ω



10 kΩ



4.7 Ω

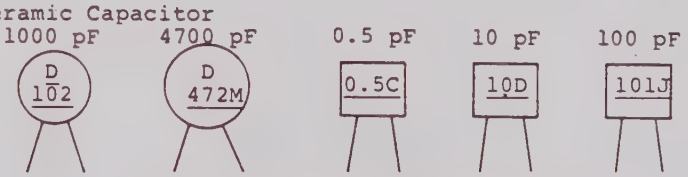
(3) Reading capacitance

Examples: 103 = 10,000 pF = 10^{-8} F or 0.01 μF
302 = 3,000 pF = $3x10^{-9}$ F or 0.003 μF
676 = 67,000,000 pF = $67x10^{-6}$ F or 67 μF

(a) Ceramic and polyester capacitors

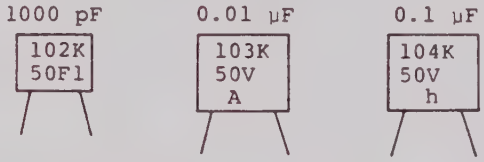
Indication	0.5	1	10	101	102	103	104
Capacity	0.5 pF	1 pF	10 pF	100 pF	1000 pF	0.01 μF	0.1 μF

Example:
Ceramic Capacitor



Capacity values are always underlined.

Polyester Capacitor

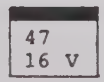


(b) Tantalum, metallized, and electrolytic capacitors

Indication	OR47	010	100	101
Capacity	0.47 μF	1 μF	10 μF	100 μF

(c) Chip tantalum capacitance

Indication	0.47	4.7	47
Capacity	0.47 μF	4.7 μF	47 μF



47 μF
16 V

(4) Reading chip ceramic capacitance

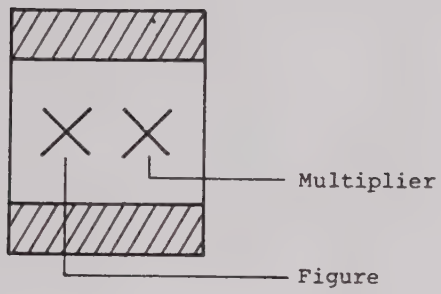
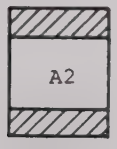
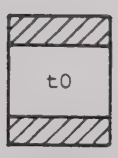


Figure						Multimeter	
Indicated alphabetic character	Corresponding value	Indicated alphabetic character	Corresponding value	Indicated alphabetic character	Corresponding value	Indicated value	Corresponding multiplier
A	1.0	M	3.0	Y	8.2	0	10^0
B	1.1	N	3.3	Z	9.1	1	10^1
C	1.2	P	3.6	a	2.5	2	10^2
D	1.3	Q	3.9	b	3.5	3	10^3
E	1.5	R	4.3	d	4.0	4	10^4
F	1.6	S	4.7	e	4.5	5	10^5
G	1.8	T	5.1	f	5.0	6	10^6
H	2.0	U	5.6	m	6.0	7	10^7
J	2.2	V	6.2	n	7.0	8	10^8
K	2.4	W	6.8	t	8.0	9	10^{-1}
L	2.7	X	7.5	y	9.0		

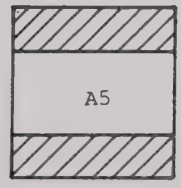
Examples:



100 pF



8 pF



0.1 µF

9.4 Parts Lists

Parts List: ML9002A

CKT REF	DESCRIPTION	RATING		NOTE
A 1	CONTROL PC board, (W32U7842)			
A 2	AMP PC board,(W32U5830)			
J 1	Cable,(W4J15208)			
Z 1	Connector,(FSN-21A-20)	20pins		
Z 2	Battery,(4N-800AR)			

M-1

( ): Manufacturer's part number

* : Selected at factory

Parts List: A1 CONTROL (ML9002A)

CKT REF	DESCRIPTION	RATING	Qty	NOTE
B 1	Buzzer,(PKM11-4A0)		1	
C 1	Cer, (CM316Y5V105Z25VBB)	1μF,+80/-20%,25V	1	
C 2	Cer, (CM43W5R474M25VBB)	0.47μF,+80/-20%,25V	1	
C 3	Cer, (CM43W5R474M25VBB)	0.47μF,+80/-20%,25V	1	
C 4	Elect,(KRE16VB-10)	10μF,±20%,16V	1	
C 5	Elect,(KRE16VB-10)	10μF,±20%,16V	1	
C 6	Cer,(CC732CH1H220J (J1))	22pF,±5%,50V	1	
C 7	Cer,(CK733F1H104Z (A5))	0.1μF,+80/-20%,50V	1	
C 8	Cer,(CK733F1H104Z (A5))	0.1μF,+80/-20%,50V	1	
C 9	Cer,(CK733F1H104Z (A5))	0.1μF,+80/-20%,50V	1	
C 10	Cer,(CK733F1H104Z (A5))	0.1μF,+80/-20%,50V	1	
C 11	Cer,(CK737B1H224K (IJ5))	0.22μF,±10%,50V	1	
C 12	Cer,(CK737B1H224K (IJ5))	0.22μF,±10%,50V	1	
C 13	Cer,(CK733F1H104Z (A5))	0.1μF,+80/-20%,50V	1	
C 14	Cer,(CK733F1H104Z (A5))	0.1μF,+80/-20%,50V	1	
J 1	Connector,(FFC-3LAMEP)	3P	1	
J 2	Connector,(DIC130)	2P	1	
Q 1	IC,(HD6473238P8)		1	
Q 2	IC,(ICL7109CMH)		1	
Q 3	IC,(μPD71054G)		1	
Q 4	IC,(HD61602)		1	
Q 5	LCD,(FSD-8C13PH)		1	
Q 6	IC,(ICL7665ACSA)		1	
Q 7	Not assigned			
Q 8	Not assigned			
Q 9	Tr,(2SC1623 (L5 OR L6))		1	
Q 10	IC,(74HC4052F)		1	
Q 11	IC,(74HC00F)		1	
Q 12	IC,(TC74HC07AF)			

M-3

( ): Manufacturer's part number

* : Selected at factory

Parts List: A1 CONTROL (ML9002A)

CKT REF	DESCRIPTION	RATING	Qty	NOTE
R 1	SIL type, (RRS-8-104JA)	100kΩ,±5%,1/8W	1	
R 2	SIL type, (RRS-8-104JA)	100kΩ,±5%,1/8W	1	
R 3	SIL type, (RRS-6-104JA)	100kΩ,±5%,1/8W	1	
R 4	SIL type, (RRS-8-104JA)	100kΩ,±5%,1/8W	1	
R 5	SIL type, (RRS-8-104JA)	100kΩ,±5%,1/8W	1	
R 6	SIL type, (RRS-8-104JA)	100kΩ,±5%,1/8W	1	
R 7	SIL type, (RRS-8-104JA)	100kΩ,±5%,1/8W	1	
R 8	MF,(RN73G2A472D)	4.7kΩ,±0.5%,1/10W	1	
R 9	Var,MF,(RG4H202)	2kΩ,±20%,1/4W	1	
R 10	MF,(RN73G2A822D)	8.2kΩ,±0.5%,1/10W	1	
R 11	CM,(RK73M2A154J)	150kΩ,±5%,1/10W	1	
R 12	CM,(RK73M2A104J)	100kΩ,±5%,1/10W	1	
R 13	Not assigned			
R 14	MF,(RN73G2A273D)	27kΩ,±0.5%,1/10W	1	
R 15	MF,(RN73G2A113D)	11kΩ,±0.5%,1/10W	1	
R 16	MF,(RN73G2A183D)	18kΩ,±0.5%,1/10W	1	
R 17	MF,(RN73G2A682D)	6.8kΩ,±0.5%,1/10W	1	
R 18	CM,(RK73M2A334J)	330kΩ,±5%,1/10W	1	
R 19	CM,(RK73M2A153J)	15kΩ,±5%,1/10W	1	
R 20	CM,(RK73M2A153J)	15kΩ,±5%,1/10W	1	
R 21	CM,(RK73M2A472J)	4.7kΩ,±5%,1/10W	1	
R 22	CM,(RK73M2A102J)	1kΩ,±5%,1/10W	1	
R 23	CM,(RK73M2A102J)	1kΩ,±5%,1/10W	1	
R 24	CM,(RK73M2A102J)	1kΩ,±5%,1/10W	1	
S 1	Switch,(HL21-NS)		1	
S 2	Switch,(HL21-NS)		1	
S 3	Switch,(HL21-NS)		1	
S 4	Switch,(HL21-LSYG)		1	
S 5	Switch,(HL21-NS)		1	
S 6	Switch,(HL21-NS)		1	
X 1	Switch,(CST8.0MTW)	8MHz	1	

Parts List: A2 AMP (ML9002A)

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CK733B1H104K)	0.1μF,+80/-20%,50V		
C 2	Cer,(CK732B1H103K(A4))	0.01μF,±10%,50V		
C 3	Cer,(CK732B1H102K(A3))	1000pF,±10%,50V		
C 4	Cer,(CK732B1H103K(A4))	0.01μF,±10%,50V		
C 5	Cer,(CK732B1H103K(A4))	0.01μF,±10%,50V		
C 6	Cer,(CM56Y5V475Z25VBB)	4.7μF,+80/-20%,25V		
C 7	Elect,(KRE10VB-15UF)	15μF,±20%,10V		
C 8	Cer,(CM316Y5V105Z25VBB)	1μF,+80/-20%,25V		
C 9	Elect,(CE04C1A221A)	220μF,±20%,10V		
C 10	Elect,(KMA10VB-100UF)	100μF,±20%,10V		
C 11	Elect,(KMA10VB-100UF)	100μF,±20%,10V		
C 12	Elect,(KMA10VB-100UF)	100μF,±20%,10V		
C 13	Elect,(KMA10VB-100UF)	100μF,±20%,10V		
C 14	Elect,(CE04C1A221A)	220μF,±20%,10V		
C 15	Elect,(CE04C1A221A)	220μF,±20%,10V		
C 16	Cer,(CK924F1H104Z)	0.1μF,+80/-20%,50V		
J 1	Receptacle, (HR10A-10P-12SC)	12pins		
J 2	Receptacle, (HSJ1022-01-010)	2pins		
J 3	Receptacle, (HEC1781-01-010)	2pins		
Q 1	IC,(TC4052BF)			
Q 2	IC,(TC4052BF)			
Q 3	IC,(OPA111BM)			
Q 4	Not assigned			
Q 5	IC,(OP177GS)			
Q 6	IC,(TC4052BF)			
Q 7	IC,(TC4053BF)			
Q 8	IC,(μPC1251G)			
Q 9	Not assigned			
Q 10	IC,(74HC74F)			
Q 11	Tr,(2SK738)			
Q 12	Not assigned			
Q 13	Not assigned			
Q 14	Not assigned			
Q 15	IC,(ICL7660CSA)			
Q 16	IC,(ICL7660CSA)			
Q 17	Not assigned			
Q 18	Di,breakdown,(RD6.2MB)	5.86 to 6.53V,200mW		
Q 19	Di,(1S953)			
R 1	MF,(RR1220P100ΩB)	100Ω,±0.1%,1/16W		
R 2	MF,(RR1220P10KΩB)	10kΩ,±0.1%,1/16W		

( ): Manufacturer's part number

* : Selected at factory

Parts List: A2 AMP (ML9002A)

CKT REF	DESCRIPTION	RATING		NOTE
R 3	MF,(TRN60C-D1MΩ)	1MΩ,±0.5%,1/4W		
R 4	MF,(GS1/4B 10MΩD)	10MΩ,±0.5%,1/4W		
R 5	CM,(RM73B2B103JD)	10kΩ,±5%,1/8W		
R 6	CM,(RM73B2B103JD)	10kΩ,±5%,1/8W		
R 7	CM,var,(RGS4H502)	5kΩ,±10%,1/4W		*
R 8	CM,var,(RGS4H203)	20kΩ,±10%,1/4W		*
R 9	MF,(RR1220P20KΩB)	20kΩ,±0.1%,1/16W		
R 10	MF,(RR1220P18KΩB)	18kΩ,±0.1%,1/16W		
R 11	MF,(RR1220P1.8KΩB)	1.8kΩ,±0.1%,1/16W		
R 12	MF,(RR1220P200ΩB)	200Ω,±0.1%,1/16W		
R 13	CM,(RM73B2B103JD)	10kΩ,±5%,1/8W		
R 14	CM,(RM73B2B104JD)	100kΩ,±5%,1/8W		
R 15	CM,(RM73B2B470JD)	47Ω,±5%,1/8W		
R 16	CM,(RM73B2B103JD)	10kΩ,±5%,1/8W		
R 17	CM,(RM73B2B103JD)	10kΩ,±5%,1/8W		
R 18	CM,(RM73B2B332JD)	3.3kΩ,±5%,1/8W		
R 19	CM,(RM73B2B102JD)	1kΩ,±5%,1/8W		
R 20	CM,(RM73B2B103JD)	10kΩ,±5%,1/8W		
R 21	CM,(RM73B2B103JD)	10kΩ,±5%,1/8W		
R 22	CM,(RM73B2B104JD)	100kΩ,±5%,1/8W		
R 23	CM,(RM73B2B220JD)	22Ω,±5%,1/8W		
R 24	CF,(ARD25T1R0J)	1Ω,±5%,1/4W		
R 25	CM,(RM73B2B104JD)	100kΩ,±5%,1/8W		
R 26	CM,(RM73B2B104JD)	100kΩ,±5%,1/8W		
R 27	Not assigned			
R 28	Not assigned			
R 29	Not assigned			
R 30	Not assigned			
R 31	CM,(RM73B2B101JD)	100Ω,±5%,1/8W		
R 32	CM,(RM73B2B221JD)	220Ω,±5%,1/8W		
R 33	CM,(RM73B2B104JD)	100kΩ,±5%,1/8W		
R 34	Not assigned			
R 35	Not assigned			
R 36	Not assigned			
R 37	Not assigned			
R 38	Not assigned			
R 39	CM,(RM73B2B333JD)	33kΩ,±5%,1/8W		
R 40	CM,(RM73B2B333JD)	33kΩ,±5%,1/8W		
S 1	Switch,(SSSJ11 1-2(A)NS)			
S 2	Switch,(SSSJ11 1-2(A)NS)			

( ): Manufacturer's part number

* : Selected at factory

Parts List: MA9421A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10A-10R-12PB)	12pins		
Q 1	Not assigned			
Q 2	Si PD			
R 1	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 2	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 3	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
S 1	Switch,(SLEP223D-H)			2 Circuits/ 3 Contacts

( ): Manufacturer's part number

* : Selected at factory

Parts List: MA9422A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10A-10R-12PB)	12pins		
Q 1	Not assigned			
Q 2	Si PD			
R 1	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 2	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 3	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
S 1	Switch,(SLEP223D-H)			2 Circuits/ 3 Contacts

( ): Manufacturer's part number

* : Selected at factory

Parts List: MA9423A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10A-10R-12PB)	12pins		
Q 1	Not assigned			
Q 2	Si PD			
R 1	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 2	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 3	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
S 1	Switch,(SLEP223D-H)			2 Circuits/ 3 Contacts

( ): Manufacturer's part number

* : Selected at factory

Parts List: MA9621A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10A-10R-12PB)	12pins		
Q 1	Not assigned			
Q 2	InGaAs Di,photo, (FID13Y13TX1005)			
R 1	CM,Var,(RJ-5X 50KΩ)	50kΩ,1/4W		*
R 2	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 3	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 4	CM,(RK73M2A273J)	27kΩ,±5%,1/10W		
S 1	Switch,(SLEP223D-H)			2 Circuits/ 3 Contacts

M-3

( ): Manufacturer's part number

* : Selected at factory

Parts List: MA9721A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10A-10R-12PB)	12pins		
Q 1	Not assigned			
Q 2	Ge Di,photo,(B1919-02)			
R 1	CM,Var,(RJ-5X 50KΩ)	50kΩ,1/4W		*
R 2	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 3	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 4	CM,(RM73M2A223J)	22kΩ,±5%,1/10W		
S 1	Switch,(SLEP223D-H)			2 Circuits/ 3 Contacts

( ): Manufacturer's part number

* : Selected at factory

Parts List: MA9722A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10A-10R-12PB)	12pins		
Q 1	Not assigned			
Q 2	Ge Di,photo,(B1918-01)			
R 1	CM,Var,(RJ-5X 50KΩ)	50kΩ,1/4W		*
R 2	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 3	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 4	Not assigned			
S 1	Switch,(SLEP223D-H)			2 Circuits/ 3 Contacts

M-2

( ): Manufacturer's part number

* : Selected at factory

Parts List: MA9723A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10A-10R-12PB)	12pins		
Q 1	Not assigned			
Q 2	Ge Di,photo,(B1720-02)			
R 1	CM,Var,(RJ-5X 50KΩ)	50kΩ,1/4W		*
R 2	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 3	CM,var,(RJ-5X 20KΩ)	20kΩ,1/4W		*
R 4	Not assigned			
S 1	Switch,(SLEP223D-H)			2 Circuits/ 3 Contacts

( ): Manufacturer's part number

* : Selected at factory

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